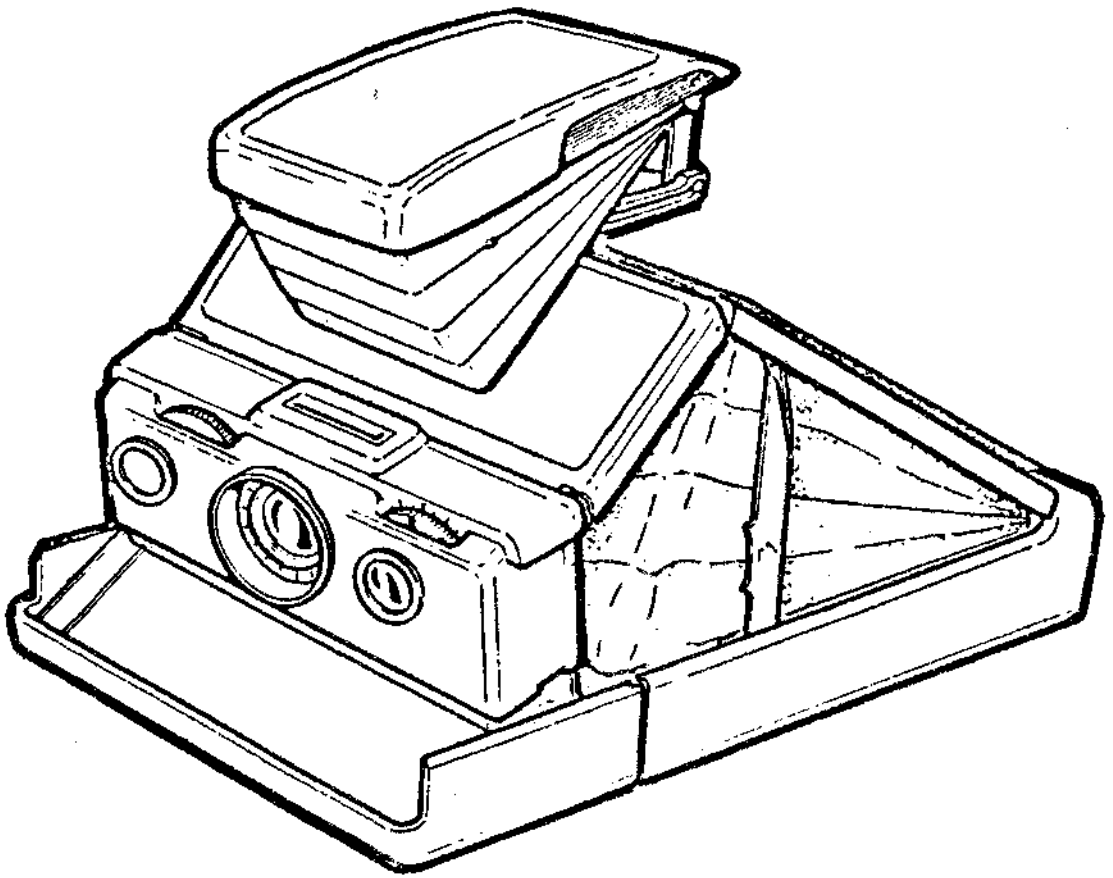
SX-70 CAMERA REPAIR BOOK



I - DESCRIPTION

A. GENERAL DESCRIPTION

The Polaroid Land SX-70 is a folding, pocket sized, single-lens reflex camera which takes and immediately delivers full-color pictures approximately 3¼ inches square (see Figures 1-1, 1-2 and 1-3). Operation is automatic. The user merely inserts the film, focuses and shoots. Power is provided by a six-volt battery inside the film pack; therefore, the batteries are always as fresh as the film.

The four element lens has a maximum aperture of f/8, and a focusing range from 10.4 inches to infinity. The shutter is automatically controlled by a photocell and electronic timing. Electrical to mechanical energy conversion is accomplished by two solenoids and a motor. There is no separate diaphragm adjustment. The shutter opening and closing time is controlled by the exposure measuring system.

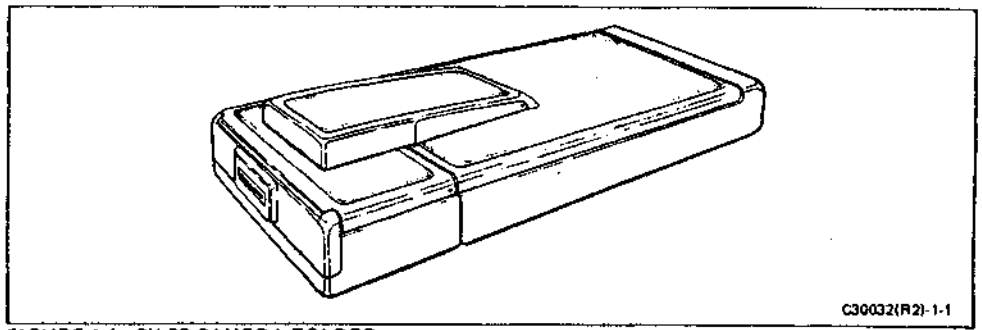


FIGURE 1-1 SX-70 CAMERA FOLDED

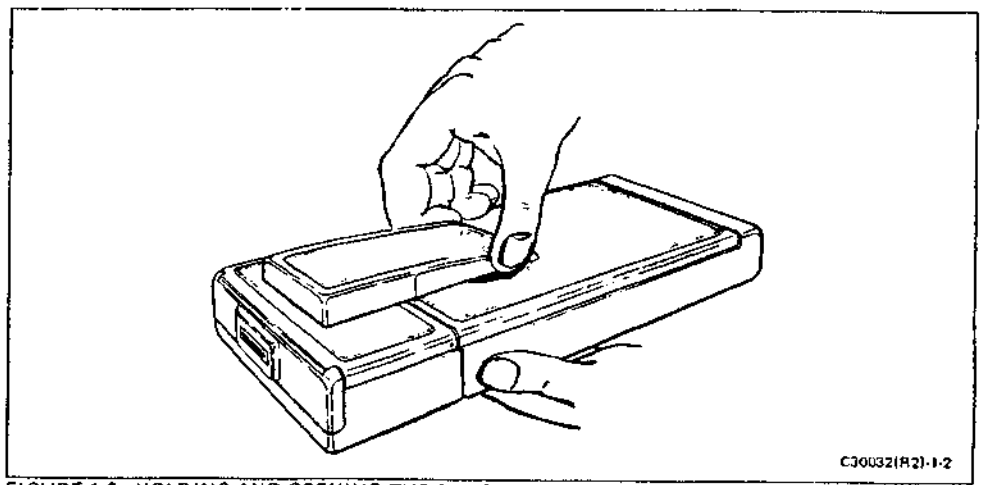


FIGURE 1-2 HOLDING AND OPENING THE SX-70

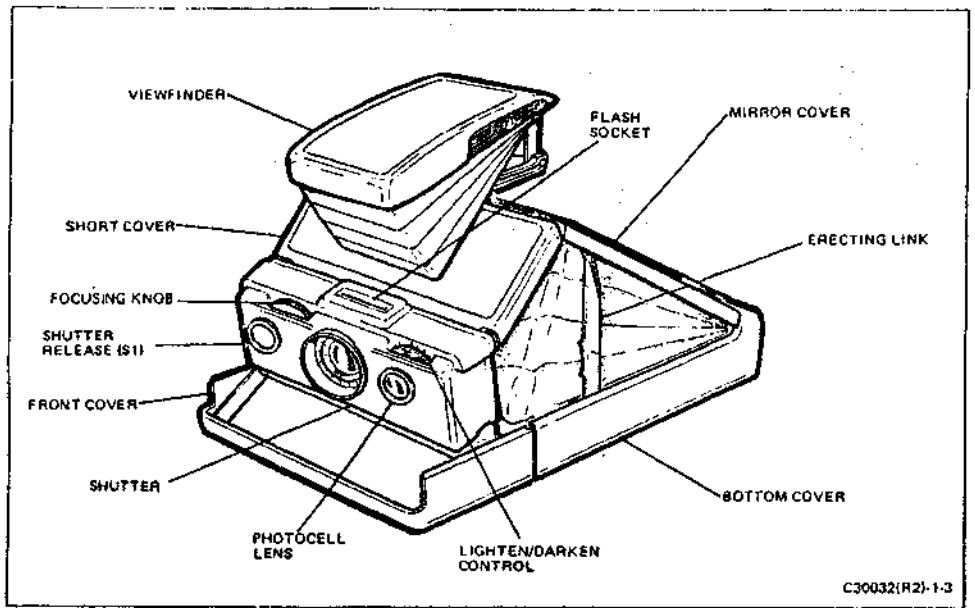


FIGURE 1-3 OPENED FOR PICTURE TAKING

The subject is viewed and focused through the taking lens, a mirror, a fresnel viewing screen (with split-image focusing aid) and an optical system to focus the image at the viewing eyepiece. As in all single-lens reflex cameras, the shutter must be open to provide an image at the eyepiece. This requirement is fulfilled by the automatic electro-mechanical components which are described in detail in Section II of this manual.

When the exposure is made, the image must be transferred from the viewing system to the surface of the film in accurate focus. To accomplish this, the shutter closes and the viewing screen swings out of the optical path which is then diverted by a mirror to the film surface. These two paths are described in greater detail elsewhere in this section.

The exposure is made following the viewing screen/mirror swing. The screen then returns to the viewing position and the automatic mechanism ejects the exposed sheet of film. Development takes place outside the camera and can be observed by the operator. As soon as the print is ejected, the mechanism completes its cycle to prepare for the next exposure. Following the tenth exposure, the flash circuit is inhibited until a fresh film pack is inserted. Normal operation will resume when the camera is reloaded.

B. CAMERA OPERATION

The following paragraphs describe the electromechanical events that occur in normal operation. The purpose of this description is to acquaint the reader with the manner in which the various functions are accomplished. Detailed analysis at a component/sub assembly level appears in Section II.

1. Opening the Camera

When the SX-70 is folded, an interlock switch (S6) removes all battery power from the camera mechanism to prevent any drain from the film-pack-encapsulated batteries. To prepare the camera for picture taking, hold the camera in the left hand, pull straight up on the serrated portion of the viewfinder housing (Figure 1-2). This action releases latches, which, in turn, allow the main body of the camera to raise into operating position. When the camera is fully opened, the interlock switch (S6), located at the left rear corner of the mirror cover, is closed and the battery is connected to the camera electrical circuitry (Figure 1-4).

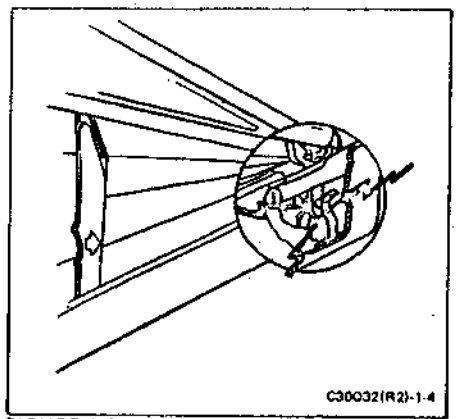


FIGURE 1-4 S6 WITH CONTACTS CLOSED

2. Loading the Film Pack

The front cover latch is located on the right side of the camera just inside the rim of the bottom cover assembly. Pressing down on this yellow latch releases the front cover which drops down to expose the film chamber. With the cover open, a film pack can be inserted or an exhausted pack can be removed.

A fresh film pack is loaded into the film chamber observing color coding (Figure 1-5). Under certain circumstances a partially used pack could be inserted, but this action will cause some deviation in the normal counting sequence.

The battery is a part of each film pack, and the two exposed terminals on the pack engage two contacts within the film chamber as the pack is inserted.

3. Starting the Automatic Mechanism

With the film pack in place, the front cover can be closed. It must be fully closed and latched.

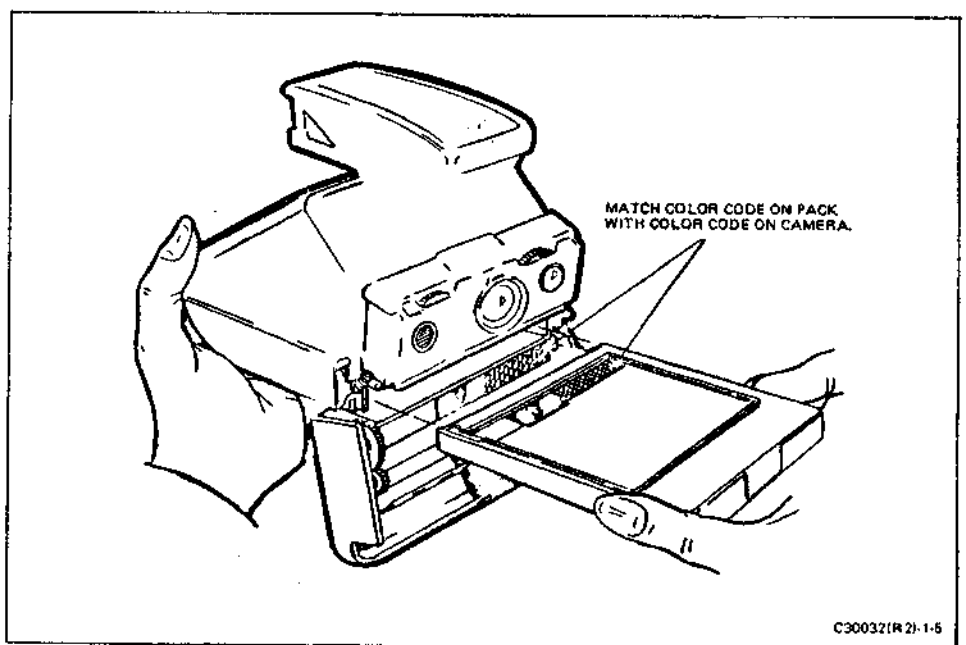


FIGURE 1-5 INSERTING FILM PACK

Gears in the front cover must engage the main gear train of the camera before the gear train is put into motion. A switch (S7) located in the forward section of the gear train compartment initiates the application of power to the gear train drive motor. Switch S7 is actuated by two components.

(1) A projection on the front cover latch (Figure 1-6A), and

(2) A post on the right rear edge of the front cover (Figure 1-6B).

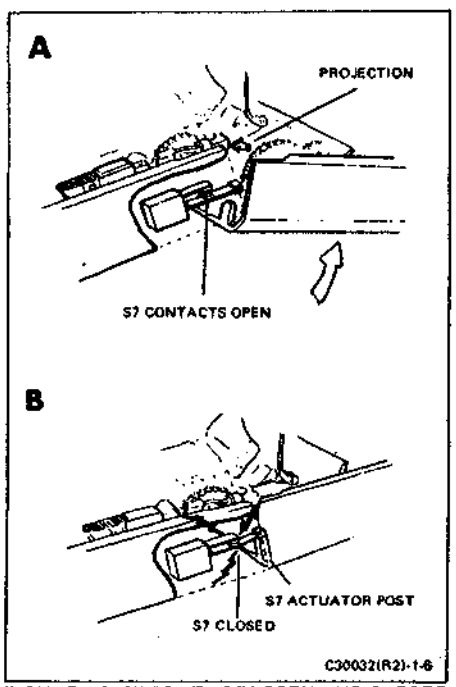


FIGURE 1-6 S7 CONTACTS OPEN AND CLOSED

Thus, the cover must be fully closed, the gears engaged, and the latch fully seated, in order to actuate the drive motor.

As S7 closes, power is applied to the drive motor (S8 is also involved and is discussed in a following paragraph), the gear train is set in motion and actuates a device called the film pick. The pick engages the dark slide, pushes it into the spread rolls and the dark slide is ejected from the lower front edge of the front cover. The camera is now ready to take the first picture.

4. Setting the Exposure Counter

When a used film pack is removed from the film chamber, the action automatically resets the exposure counter at the rear of the camera to the start position, closing S8. With a new film pack installed and the front cover closed and latched (S7 closed), the motor is powered, and the dark slide is ejected. The exposure counter turns to number 10 (Figure 1-7), indicating that 10 pictures remain in the pack.

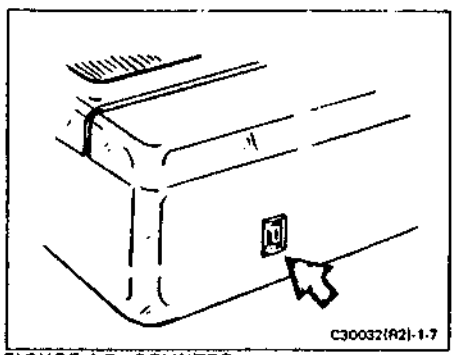


FIGURE 1-7 COUNTER

5. Viewing and Focusing

Viewing and focusing is accomplished through a reflex system (Figure 1-8A). In the viewing mode the image passes through the lens to a fixed mirror which reflects it down to the fresnel viewing screen. The viewing path from the viewfinder eyepiece lens is from a parabolic mirror and wafer lens, off the fixed mirror to the fresnel screen. On most cameras the fresnel screen contains a circular split-image area which is used as a focusing aid. A knurled knob (the focusing wheel) on the shutter housing is rotated to adjust the camera focus. The scene is in focus when a vertical line within the split-image area is perfectly straight. On early cameras (without a split-image feature), the scene is in focus when the image seen on the fresnel screen is sharpest.

6. Making the Exposure

The exposure is made by pressing the release button. This completes the electrical circuit to the shutter to initiate a series of events. The shutter blades close to cut off the optical path. The hinged fresnel viewing screen is swung upward and comes to rest in front of the fixed viewing mirror (Figure 1-8B).

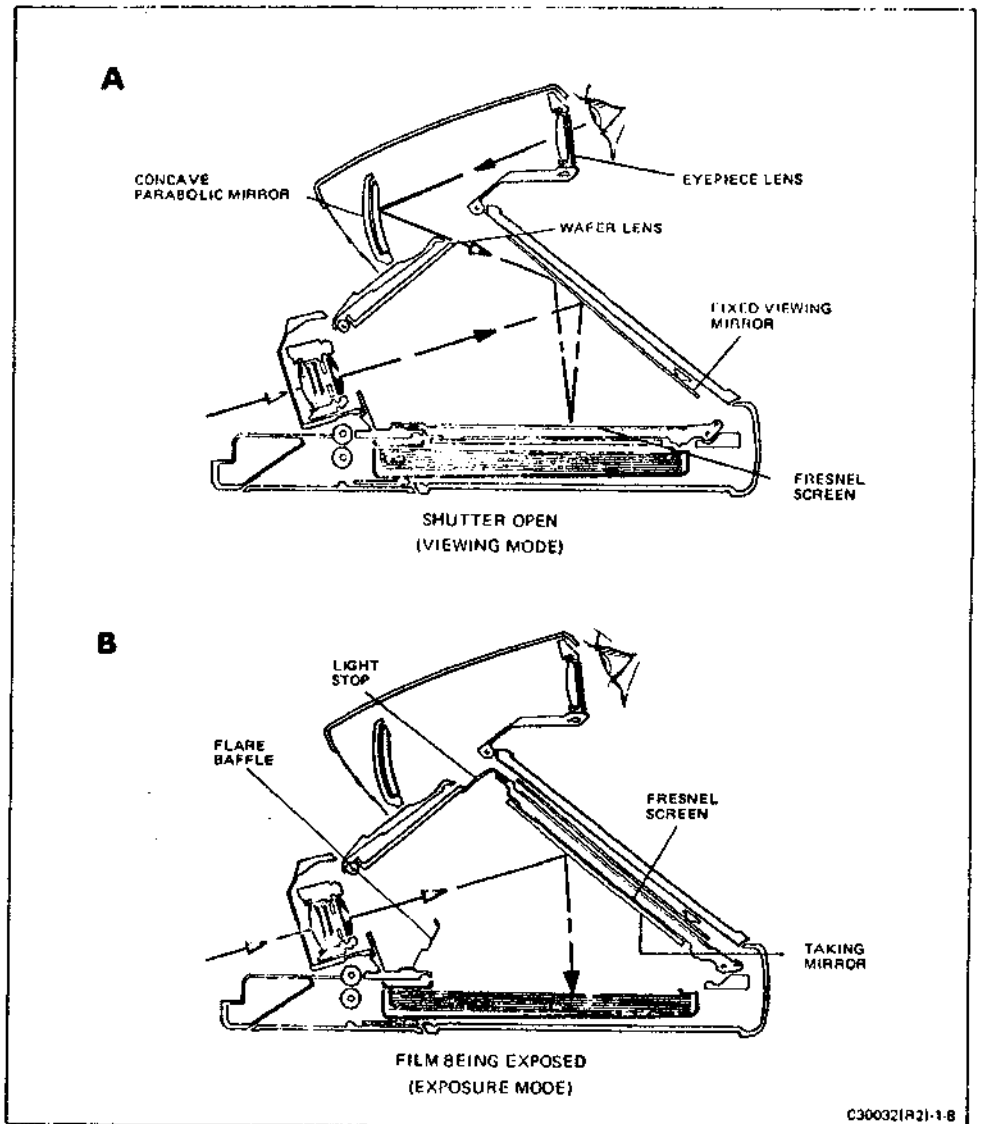


FIGURE 1-8 VIEWING AND SHOOTING

The shutter opens and closes to perform the exposure function.

A first-surfaced taking mirror is fastened to the underside of the fresnel carrier assembly. The

image is reflected by this mirror onto the film surface. The electronic metering system determines the required exposure, and programs the shutter opening and duration accordingly.

The incorporation of a mirror in the lens-to-film path is necessitated by the nature of the film. No separate negative is employed. Instead, the image appears as a direct positive. Since the final product is an opaque print, it is viewed by reflection. As a result, the mirror is needed to reverse the image so that the final print will be properly oriented. This requirement, in turn, dictates the use of the reflectance type viewing screen rather than a ground-glass type transmission system.

Note that the film surface is displaced from the fresnel viewing screen by the thickness of the viewing screen assembly. The correct focal distance for both viewing and exposure is properly maintained, however, since the surface-coated exposure mirror is displaced by the same dimension.

During exposure, the light from the viewing system must be prevented from striking the film. This is accomplished by a rubber light stop adhered to the hinged fresnel carrier. When the fresnel carrier moves upward, the light stop blocks off light from the viewfinder eyepiece.

As indicated by the foregoing description, the viewing system is blacked out during the actual exposure.

As soon as the exposure is complete the mechanism returns the viewing screen to its initial position and the pick feeds the exposed film to the spreader rolls. The rolls break the pod, spread the developer, and eject the film from the camera.

7. Completing the Filmpack

As each exposure is completed, the exposure counter subtracts one digit until the ten exposures have been made. The counter then indicates (0). When this occurs, switch S9 is closed. Closing this switch inhibits the flash and exposure timing. Since the counting cycle is initiated by the insertion of a film pack, the pack may not necessarily contain a full supply of film. If, for some reason, a partially used pack is removed and reinserted, the top film will be the dark slide. The counter will start at number 10. Since switches S8 and S9 are physically attached to the counter, the camera will cycle through 10 exposures even though there be less than 10 sheets of film in the pack. This deviation must be recognized whenever a partially exposed pack is used.

8. Developing the Print

As in other Polaroid pack cameras, the picture is developed outside the camera. Unlike previous Polaroid Land Cameras, however, there is no negative to peel off and discard.

Thus, there is no requirement for a development timing cycle. The nature of the film is such that, once delivered from the camera, the picture will assume its final appearance automatically with no further attention by the operator.

9. Exposures Using Flash

The SX-70 accepts a special 10-lamp flash bar that plugs into a receptacle directly over the camera lens. There are five lamps in a row on either side of the bar which must be removed, rotated, and reinserted after the fifth lamp has been fired (Figure 1-9).

Inserting a flash bar into the flash socket closes switch S2 in the socket. This action sets up the shutter electronic circuit to permit firing of the flash lamp. A follow-focus mechanism, coupled to the lens focusing system arrests the shutter blades at an opening related to camera-to-subject distance.

NOTE: On early camera models, the light measuring circuit remains active even with the flash bar inserted into the socket. If the circuit determines that there is sufficient ambient light, an exposure will be made without the flash. Cameras with "P" configuration or later shutters, do not have this light measuring feature in the flash mode. Regardless of the ambient light level, the circuits will fire the flash when a flash bar is in the socket (unless, of course, the lamps have all been used).

If the array has been exhausted, the shutter will complete the exposure cycle without flash. Maximum exposure duration is thirty seconds.

When the exposure counter reaches 0 (empty) the camera will not fire a flash lamp even though unused lamps remain in the bar. The previously discussed deviation associated with the exposure counter is applicable to the flash functions. If an unused lamp is in position and if a partially empty film pack has been reinserted, the camera will continue to fire lamps after the last sheet of film has been exposed, until the counter reaches zero.

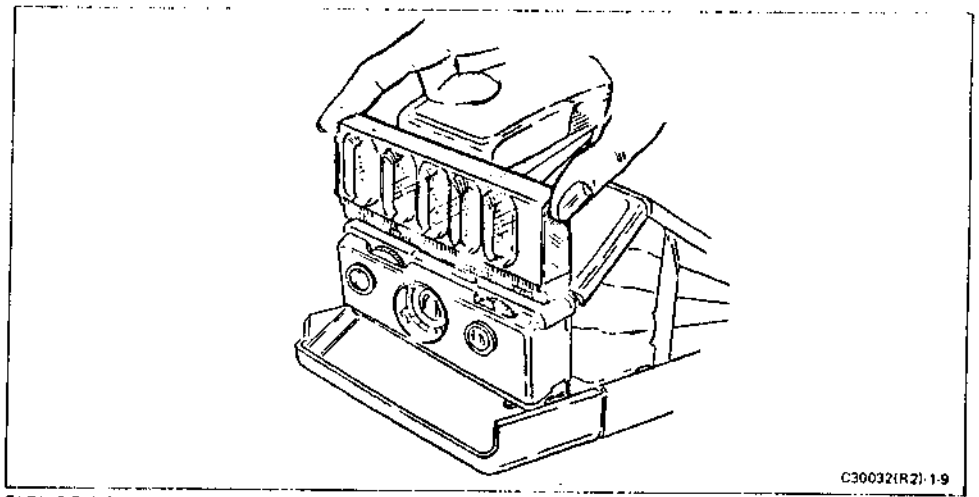


FIGURE 1-9 INSERTING THE FLASH BAR

10. Closing the Camera

When through using the camera it can be folded and latched in its closed configuration by pushing the erecting link. When the camera is closed, the interlock switch (S6) is opened so that the battery is completely disconnected from the camera circuits. The trim wheel (the lighten/darken adjustment associated with the photocell) automatically returns to its normal position each time the camera is closed.

C. SHUTTER DESCRIPTION (AMBIENT LIGHT MODE)

The shutter employed in the SX-70 camera is unique. No direct comparisons should be drawn between the manner in which it functions and the function of other Polaroid electronic shutters. No manually adjustable or fixed aperture is employed. When a picture is taken, two shutter blades, with specially shaped cutouts, open the lens from a totally closed position to a suitable aperture. The two blades then reverse direction and again shut off the optical path. These same two blades also contain a similar (although differently shaped) pair of cutouts that open and close the light path to the photocell in like manner. In the following description the function of the photocell cutouts is deferred until the action of the shutter cutouts is explained although, in operation, the two functions are interdependent.

When the camera is open for viewing, but before the release button is pressed, solenoid #1 is de-energized and the shutter blades are open. A spring (opening spring) holds the shutter blades wide open (Figure 1-10). The lens thus provides maximum viewing/focusing brilliance. Solenoid/spring action is discussed in detail in the next section of this manual.

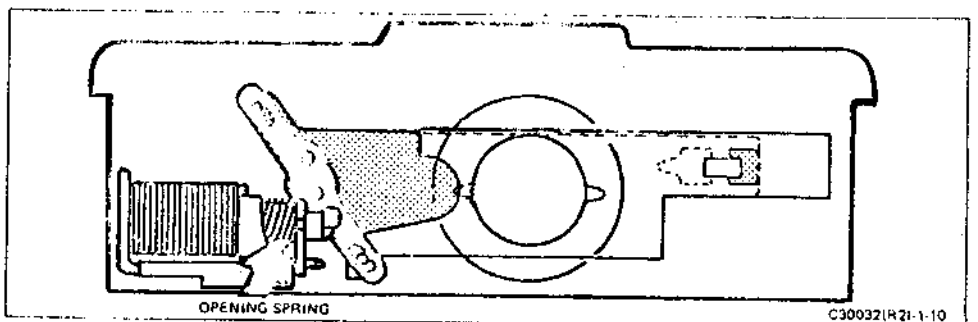


FIGURE 1-10 SHUTTER BLADES HELD OPENED

When the release button is pressed, a switch S1 closes (Figure 1-11A and B) and applies operating power to the shutter. As soon as power is applied to the shutter, solenoid #1 is energized and rapidly moves the shutter blades to the closed position.

When the solenoid has reached the end of its stroke (shutter closed), it no longer requires maximum current to hold it at that position. Switch S4 (located on solenoid #1) closes (C-B) and activates an electronic circuit called the POWER DOWN CIRCUIT. This reduces power to an adequate level to hold the solenoid after the high-current circuit has completed the solenoid operating function and switches on the motor drive circuit. Thus, the shutter will remain closed, with minimum battery drain.

Light entering the lens is now cut off and the reflex mirror is swung upward to picture-taking position. The electronic latch (activated by opening S5) assures that the sequence will be completed even if the operator removes his finger from the exposure button, S1.

When the mirror swings up, a mechanically operated switch (S3) actuates a "Y" delay circuit (40 milliseconds)(Figure 1-12) so that the shutter will not function until mirror bounce has subsided. At the end of the delay period the electronic circuitry removes the power from the solenoid and the opening spring sets the shutter blades in motion toward the full open position. At the same instant an electronic switch opens and starts the integration cycle. The integration cycle is that period during which the total amount of light (intensity and duration) reaching the photocell is transformed electronically to regulate the length of time the film is exposed. The shape of the opening in the shutter blades and the motion of the blades is such that all of the factors involved are continously variable throughout the exposure period. This fact, however, is a design consideration and should not confuse the theory of shutter operation from a maintenance point of view.

When the camera completes all of its automated functions and the release button has been released, all voltage is removed from solenoid #1 and the shutter opens in preparation for the next exposure.

It should be noted that under extremely low light conditions, the shutter will close completing the exposure cycle in 14 to 30 seconds whether a suitable exposure has been produced or not.

D. SHUTTER DESCRIPTION (FLASH MODE)

The special ten-shot flash bar is equipped with a shorting bar so that when the bar is inserted, two contacts within the camera are shorted. This switch is identified as S2. When S2 is closed, the shutter electronic circuit detects that a flash bar is in place and ready for firing. In general, the sequence of functions remains the same as for ambient light operation with the following exceptions:

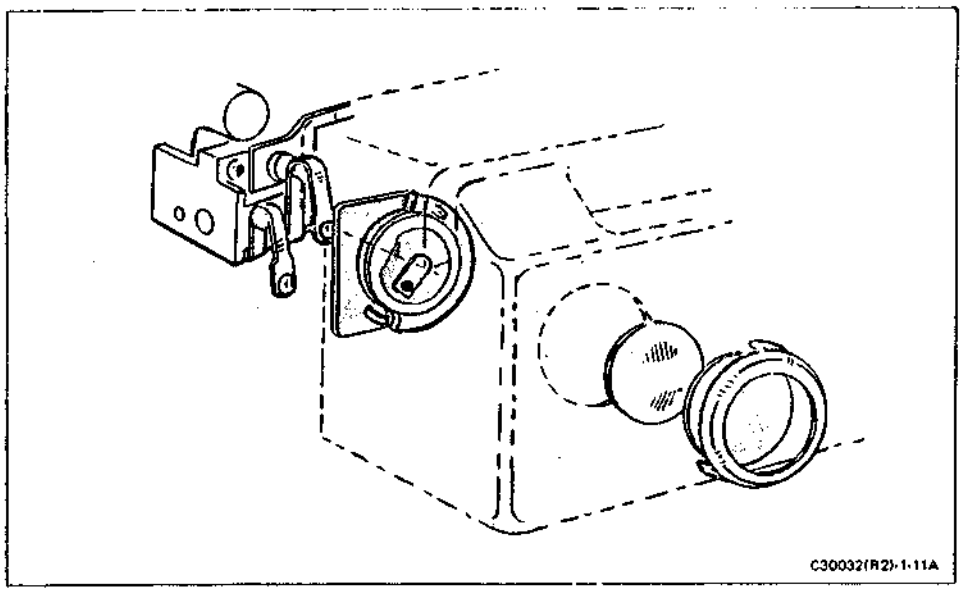


FIGURE 1-11A S1 – LOCATION & ARRANGEMENT OF INTERNAL PARTS

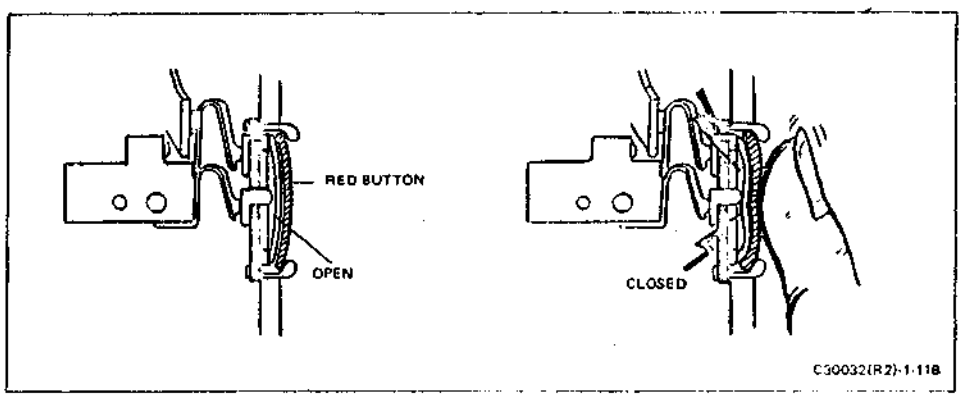


FIGURE 1-11B S1 – OPERATION

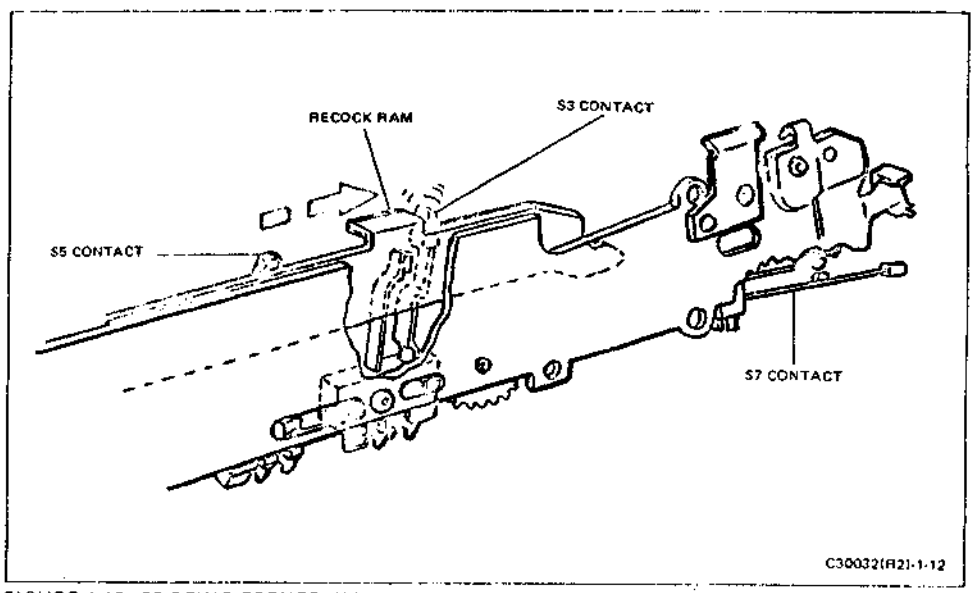


FIGURE 1-12 S3 BEING OPENED BY RECOCK RAM

A mechanical device identified as the interceptor is connected to the lens focusing mechanism (Figure 1-13A). The interceptor is moved as the lens is focused regardless of whether ambient-light or flash pictures are being taken. When a flash bar is in place (S2 closed) and the gear train opens switch S5 (Figure 1-14), solenoid #2 is energized and pulls the interceptor into position to physically restrict the shutter blade travel (Figure 1-13B). Since the interceptor is controlled by the focusing mechanism, the shutter opening is related to camera-to-subject distance thus compensating for the flashbulb-to-subject distance to give the proper flash exposure. As solenoid #1 de-energizes switch S4 moves from the C-B position to the C-A position. This switch connects VCC to the FFA.

When the flash delay period reaches completion, the circuitry removes the holding current from solenoid #2. Since the solenoid is an electro-mechanical device, removing power from it causes a collapsing magnetic field which induces a fly back voltage. This voltage pulse is fed to the flash circuitry which then applies the firing voltage across the flash lamp.

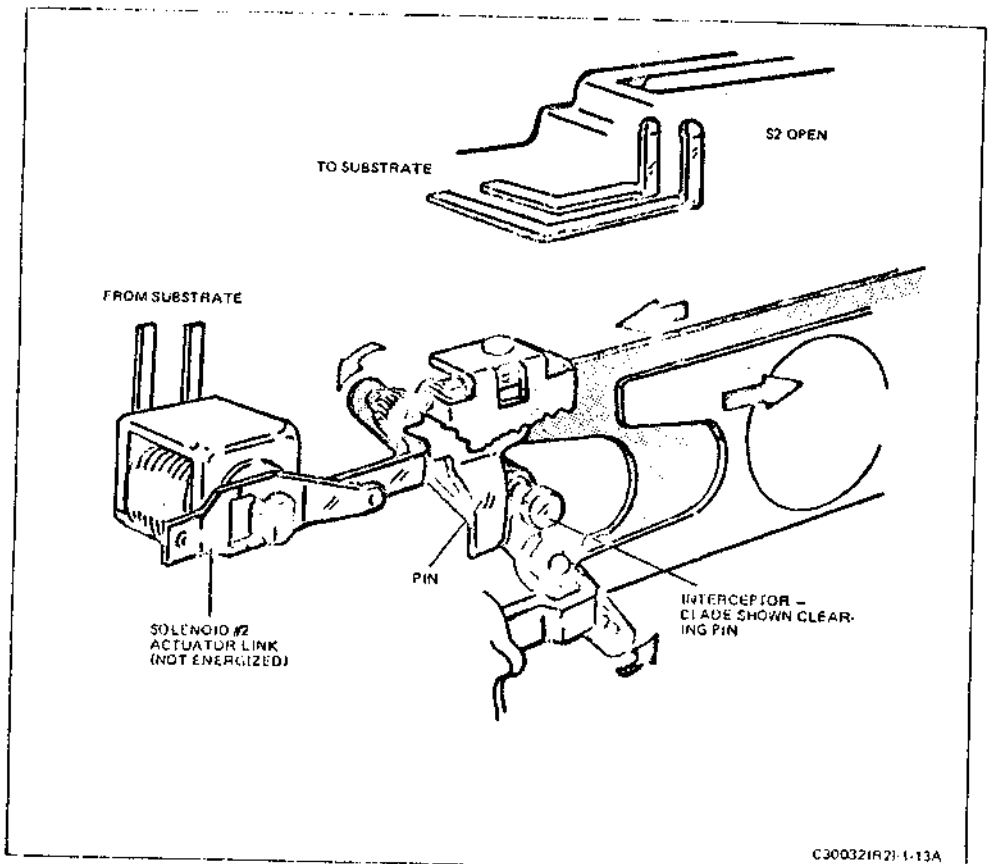


FIGURE 1-13A INTERCEPTOR LINK, SOLENOID 2, S2 OPERATION – SOLENOID DEENERGIZED

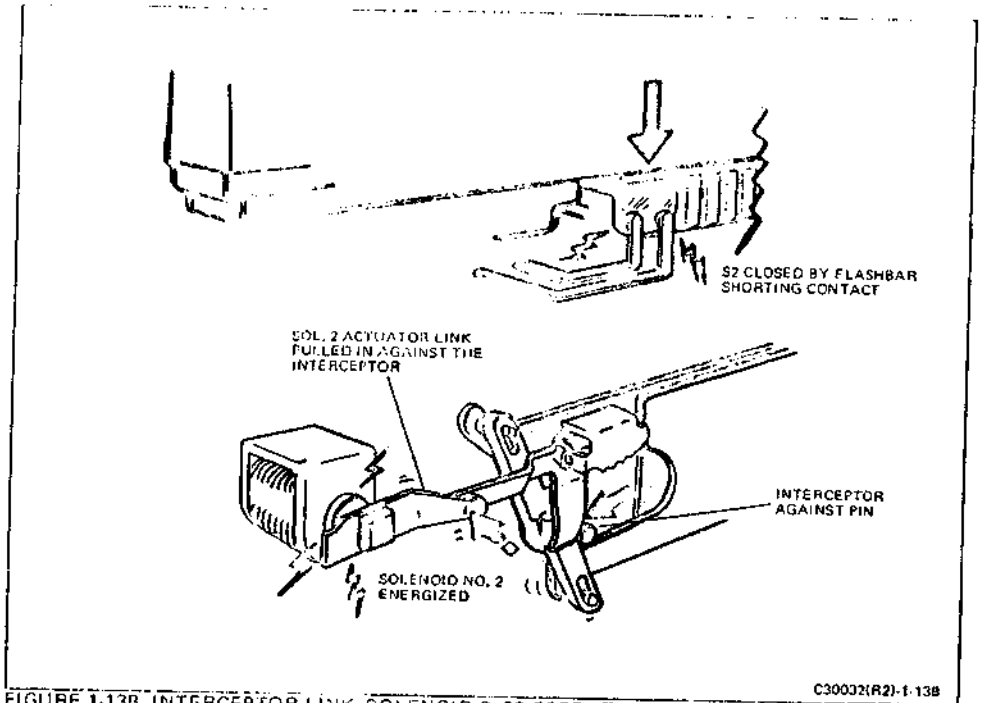

S2 CLOSED BY FLASHBAR SHORTING CONTACT
SOL. 2 ACTUATOR LINK PULLED IN AGAINST THE INTERCEPTOR
INTERCEPTOR AGAINST PIN
SOLENOID NO. 2 ENERGIZED
C30032(R2)-1-13B

FIGURE 1-13B INTERCEPTOR LINK, SOLENOID 2, S2 OPERATION – SOLENOID ENERGIZED

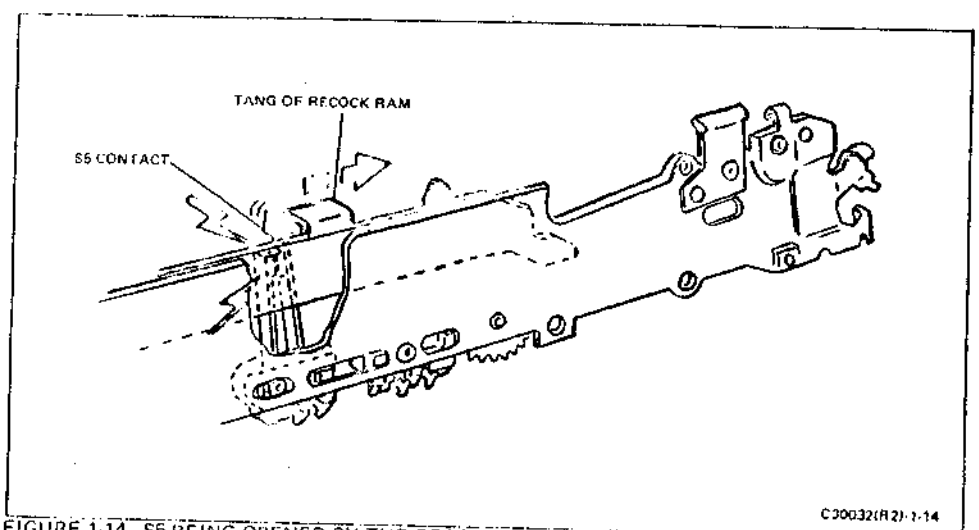


FIGURE 1-14 S5 BEING OPENED BY THE RECOCK RAM (GEAR TRAIN)

In cameras with "P" configuration or later shutters there is no ambient light measurement made. If a flash bar is in the shutter socket a flash picture will result regardless of the ambient light level.

On early cameras, an ambient light measurement is made during the flash delay period. Since the photocell aperture is a part of the shutter blades, the amount of reflected light reaching the cell will also be a function of focusing distance. The shutter electronics delays firing the flash lamp until the shutter has opened to the aperture established by the focus wheel. During this delay period, if the ambient light level is sufficiently high to cause triggering of the integrating circuits, the exposure will be completed and the shutter closed before the firing voltage reaches the lamp and the lamp will not be fired.

The flash circuit just mentioned performs two additional functions. It produces a signal that shorts out the integrating (exposure timing) capacitor and thus discharges the capacitor so that it can repeat the integrating function. The same signal also initiates the flash time-out interval.

At the end of the flash timing interval, the circuit energizes solenoid #1, the shutter closes, and the sequence proceeds as in the ambient-light mode.

If the bulbs in the flash bar are all used when the operator attempts to make a flash exposure, all of the previously described circuitry will function up to the actual firing of the flash lamp. Since there is no lamp to ignite, no flash firing current will be drawn.

There will be no output signal from the flash sequencing circuit, and an ambient light exposure will be made. On cameras with "P" or later configuration shutters, the result will be a black picture unless the ambient light level is high enough to give an exposure. This is caused by the fact that "P" and later configuration shutters have no integrating function as long as a flash bar is inserted in the socket. Early cameras have a twenty second time-out period even with a flash bar inserted in the socket. Therefore, if the flash bar is exhausted, a properly exposed picture will result if the ambient light is great enough to produce one in twenty seconds.

II - THEORY OF OPERATION

A. INTRODUCTION

A general description of the camera and the sequence of its functions is contained in Section I. In that section, detailed analysis of individual assemblies and electrical circuits was minimized so that emphasis could be placed on the interrelationship of various functions. In the following paragraphs, the individual groups of components are described in greater detail. The descriptions are presented in the sequence in which the components were mentioned in Section I.

B. POWER SOURCE

Power for the drive motor, the shutter electronics, and the flash array is supplied by a specially designed six-volt battery incorporated in each ten-exposure film pack. When the pack is inserted into the camera, two contact pads on the bottom surface of the pack engage two spring-loaded contacts on the inner bottom surface of the camera bottom plate. From these two points, it is distributed to its destinations by the coppor foil strips of a flex circuit on the outer surface of the bottom plate.

The battery has adequate capacity to expose all ten film frames with at least six months of expected shelf life.

C. LENS

The lens employed is a four element, glass lens of f/8 aperture with a focal length of 115mm. It has a focusing range of infinity down to 10.4 inches. Focusing is accomplished by movement of the front element only. Helical threads in the lens mount provide the linear lens element movement. Operation is by means of a geared focus wheel at the top of the shutter housing. There is no manually adjustable diaphragm associated with the SX-70 lens.

D. VIEWING AND EXPOSING SYSTEM

When the camera is erected to picture-taking configuration, the subject can be viewed through the collapsible viewfinder. Figures 2-1 and 2-2 show the two optical paths in the camera. Note the

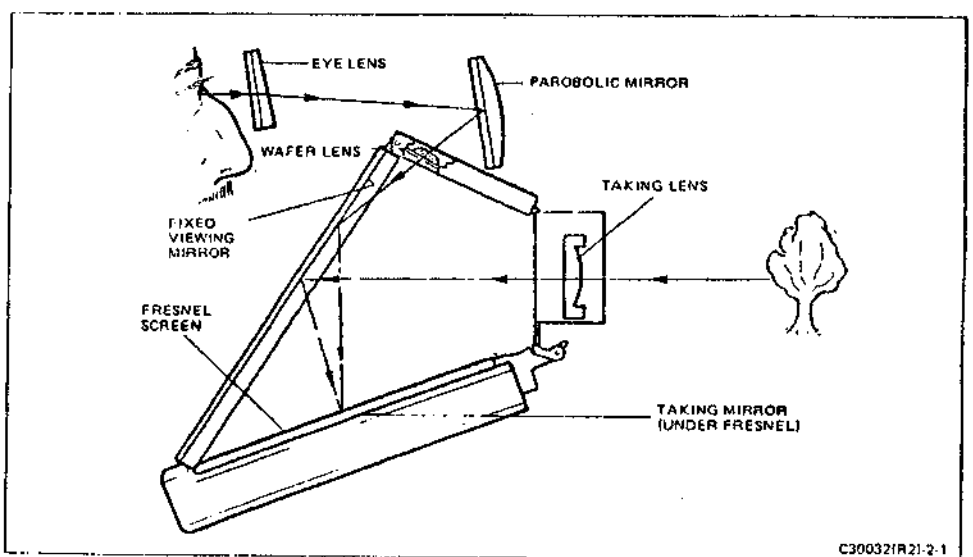


FIGURE 2-1 VIEWFINDER OPTICS (VIEWING)

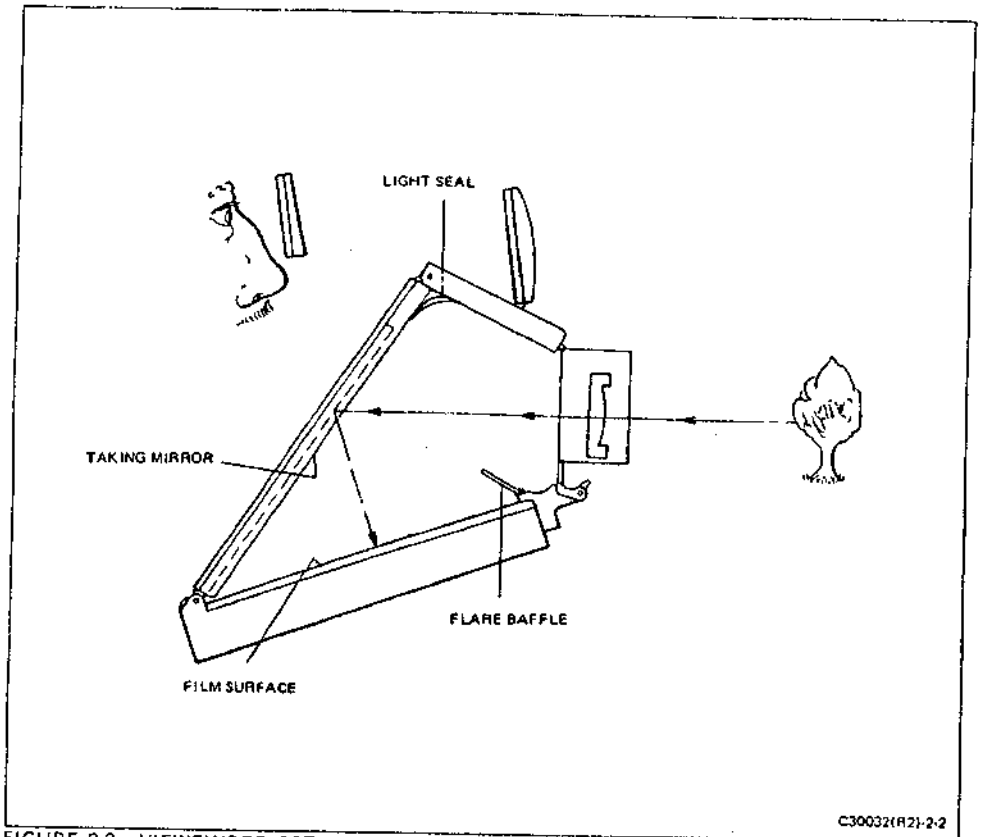


FIGURE 2-2 VIEWFINDER OPTICS (EXPOSING)

direction of the arrows. Reflected light from the subject passes through the camera lens and is reflected by the viewing mirror (on the inside surface of the mirror cover) to the fresnel viewing screen.

The entire subject image is now reproduced on the viewing screen. At this point, viewfinder optics must be employed for focusing. The optics must transfer the image from the viewing screen to the eye (done by the parabolic mirror and viewing mirror) and must present the image in a fairly sharp contrast to permit proper focusing (done by the eye lens and parabolic mirror).

1. Fresnel (Figures 2-3A & 2-3B)

The special fresnel (pronounced *Freh-nell*) screen is employed to enhance the viewing image by increasing the brightness and definition. If a matte while surface were substituted for the fresnel screen, an image would still be visible. However, the light rays striking nearest the corners of the screen meet the screen at a more oblique angle than the rays striking near the center. At this greater angle, a larger percentage of the light is dispersed and less light is returned to the viewer. Thus, on a matte-screen image the corners would appear darker than the center. The fresnel screen is designed to overcome this problem.

The screen itself is a sheet of plastic upon which are impressed a series of concentric rings much like the grooves pressed into a phonograph record (Figure 2-3) instead of having a vee shape; however, the grooves in the fresnel screen form a saw-tooth with a tooth angle increasing slightly with each successive groove in such a manner as to complement the decreasing angle of the light ray. The saw-tooth flattens out completely at the exact optical center of the screen. In the SX-70 camera, the optical center is not the geometrical center of the screen.

The surface of the screen is silvered to provide optimum reflectance. The result is a brilliant viewing image evenly illuminated from corner to corner.

For the reader who is familar with the use of a fresnel lens used in conjunction with a ground-glass focusing screen, or a fresnel-ground focusing magnifier, it must be noted that these are transmission devices while the Polaroid screen is a reflecting medium. Otherwise, the brilliance-enhancing properties are the same. A suitable analogy would be the comparison of a lenticular projection screen compared with a matte surface. The ribbed surface of the lenticular screen narrows the angle of reflectance but increases the brilliance of the image within the viewing area.

In summary, the fresnel satisfies three conditions: (1) it enhances focusing by distributing light rays evenly across the entire viewing area (2) it guarantees proper focusing by nature of its acting as a ground glass – thus insuring that the subject is in focus when the eye sees the image in focus on the screen (3) it acts as a reflecting surface to permit the eye to see the image through the viewfinder optics.

As shown in Figures 2-3A and 2-3B, two types of fresnel screens are used. Current types (Figure 2-3A) have a split-image circle cut into the center of the screen which makes focusing easier. Specially oriented prisms within the circle split the image unless the camera is perfectly focused. Therefore, a straight vertical line in the image area would appear to be broken unless the subject is in focus. To further ease focusing, the image within the split circle appears brighter than the rest of the fresnel image. This is possible because the split circle area is not coated in the same manner as the rest of the fresnel. This latter feature improves the ability of the viewer to focus the camera in dimly lit areas.

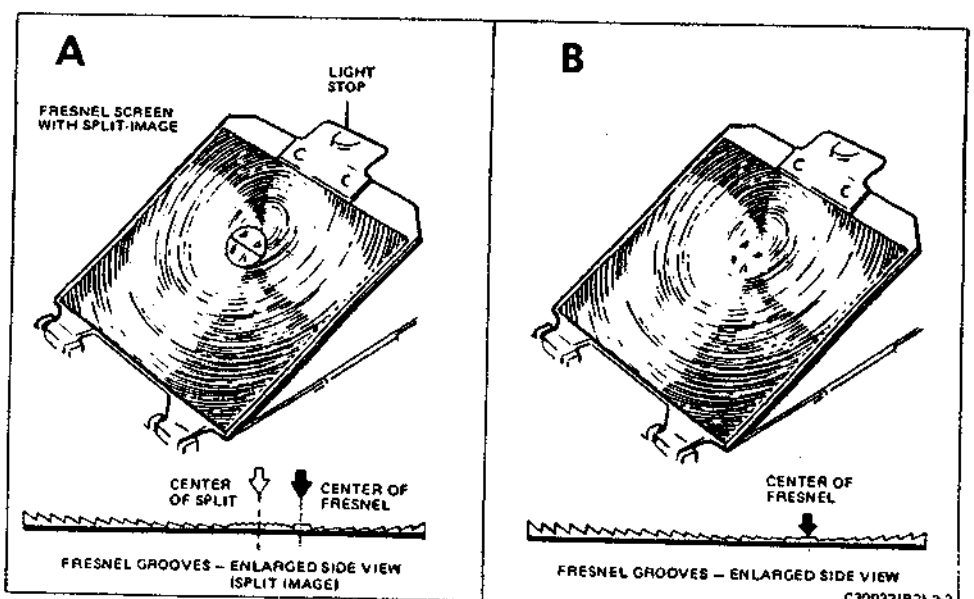


FIGURE 2-3. FRESNEL SCREEN

2. Viewfinder

The viewfinder optics consist of an eye lens, a concave mirror, and a wafer lens (Figure 2-4). As in all simple optical systems, a certain amount of distortion is inherent in this design. A small wafer lens is introduced into the viewfinder optical path to limit the angle of acceptance and, thus, reduce distortion. The size of the lens opening is large enough to provide acceptable viewing brilliance and, at the same time, small enough to be easily closed when the camera is in the exposure mode. (On earlier models a rectangular mask called a stigmatic pupil takes the place of the wafer lens.)

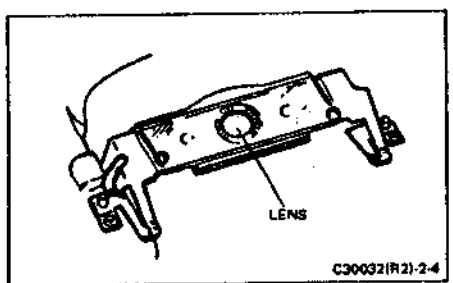


FIGURE 2-4 WAFER LENS ASSEMBLY

Ignoring the shutter functions momentarily, when the operator presses the exposure button, the fresnel carrier swings away from the film plane and comes to rest in front of the viewing mirror. During the moment of the fresnel carrier (and until it returns to its initial viewing position), a flexible light stop closes a path between the viewfinder and the inner camera to prevent light through the eye lens from reaching the film. The movement of the spring-driven fresnel carrier is accomplished by the mirror release cam which is a component of the motor-driven gear train. The details of the automated action are described in the discussion of the electro/mechanical assemblies.

3. Mirrors

Two first surface mirrors are used in the SX-70 optical system. When a picture is being taken, the fresnel carrier is raised. This places the 4-edged taking mirror into the optical path and light is reflected onto the film plane. (The taking mirror is mounted on the fresnel carrier on the side opposite the fresnel screen.) The second mirror, the 6-edged viewing mirror is used in the optical path twice. First, the light rays entering the camera from the taking lens are reflected onto the fresnel screen by the viewing mirror. Secondly, the operator views the image on the screen with light reflecting off the viewing mirror (Figure 2-1). (The viewing mirror is located on the underside of the mirror cover assembly.)

4. Flare Baffle

The flare baffle (Figure 2-2) is a spring-loaded plate which springs up when the fresnel screen moves into the picture-taking mode. In this state, light is prevented from passing through the lens directly onto the film without first being reflected off the taking mirror. This prevents "hotspots" from appearing on the finished picture. When the fresnel carrier is in the lowered position, the flare baffle is held down, out of the optical path.

E. CAMERA ELECTRONICS

1. General

The SX-70 is unique, both in its principles of operation and in its functional design. It can be considered as an electronically controlled mechanical device. An electronic control module (substrate or ECM) contains all of the electronic components with the exception of the motor control (MCC) integrated circuit and the flash fire assembly (FFA). Because the ECM is located inside the shutter housing, it becomes identified as part of the shutter (Figure 2-5). It should be noted that all of the camera automation is controlled by the integrated circuits in the ECM.

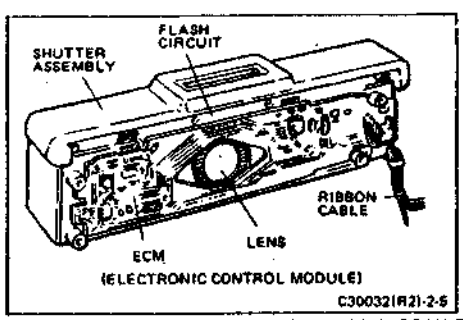


FIGURE 2-5 ELECTRONIC CONTROL MODULE (ECM)

The entire ECM (rather than its individual integrated circuits) is used as a replacement item. For that reason, the theory of operation and analysis techniques presented in this manual have been prepared in such a way that the repairman can relate a specific camera failure mode to an ECM function.

2. Switch Functions (Figure 2-6)

a. Switch S1 is actuated by either the red shutter release button or a remote control cable release. It is operated by the photographer and it causes the camera to run through a complete exposure/film delivery cycle.

b. Switch S2 places the circuitry into the flash mode. Switch S2 is closed when the flash bar is inserted into the FFA on top of the shutter housing. It commands the integrated circuit in the FFA to select the first unused flashbulb and, to fire the bulb. It also enables the ECM to energize solenoid #2 which limits the opening of the shutter blades so that flash exposure will be determined by flash-to-subject distance. When solenoid #2 is energized it engages a mechanical coupling between the shutter blades and the focusing mechanism.

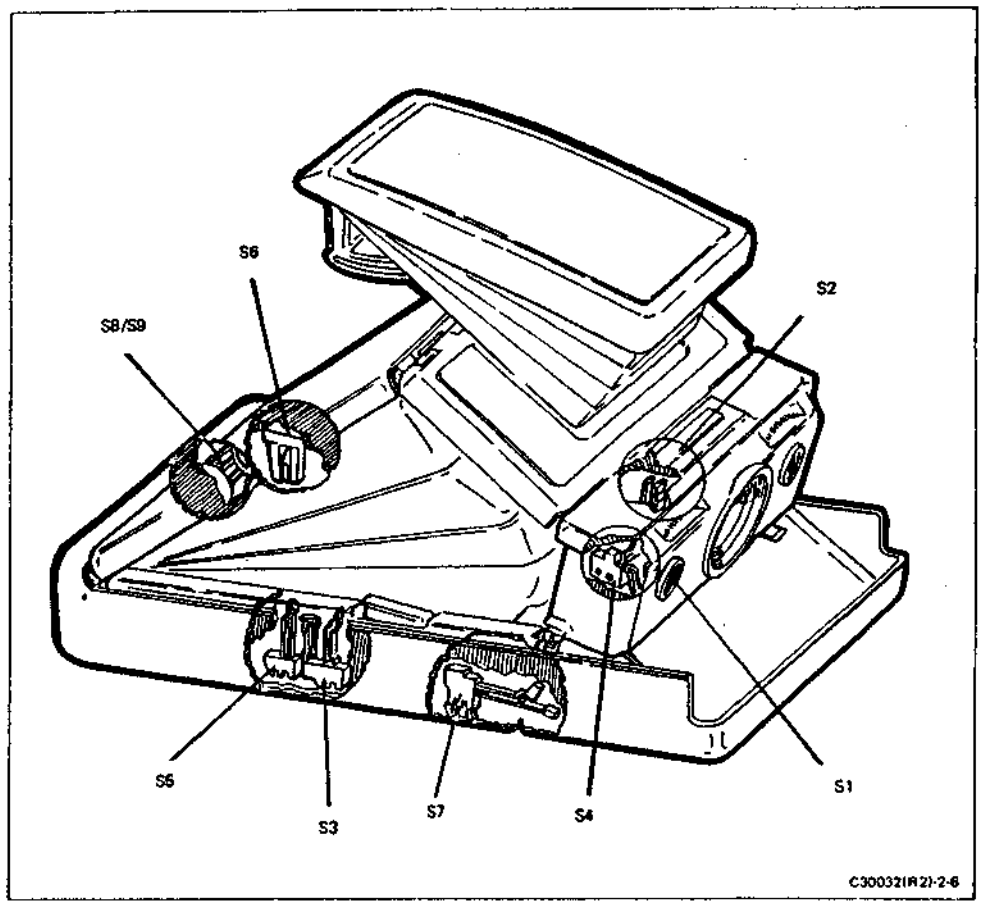


FIGURE 2-6 SX-70 SWITCH LOCATIONS

c. Switch S3, normally closed at the beginning of the exposure cycle is opened by the recock ram located in the gear train assembly. See Figure 2-7. As the exposure sequence begins, S3 opens and actuates a delay circuit (Y delay) in the EMC which retards the start of the actual exposure approximately forty milliseconds so that mirror bounce will have subsided before a picture is taken. At the end of the delay time, the shutter starts to open and the electronic timing function (integration) takes place. If a flash circuit is inserted into the FFA (S2 closed) an additional flash delay circuit is activated to insure that the exposure gets full effect of the light derived from the flash. At the end of the exposure cycle when the Fresnel carrier moves down into viewing position, S3 closes as the recock ram moves away. It is now reset for the next camera cycle.

d. Switch S4 is tripped by an actuator on the plunger of solenoid #1, the shutter blade actuating solenoid (Figure 2-8).

NOTE: Whenever the SX-70 shutter is discussed, it must be noted that, since the camera is a single-lens reflex and focusing is accomplished through the taking lens, the shutter's normal state is open, not closed as in other Polaroid cameras.

When the shutter release button is pressed and the exposure cycle is initiated full battery power is delivered to solenoid #1, closing the shutter. Once the solenoid plunger is seated it no longer requires as much power as was originally needed to overcome its static inertia. Switch S4, therefore, closes the S4 C-B contacts to the ECM and the electrical power to the solenoid coil is reduced to the "power-down" value which is sufficient to continue the exposure cycle yet low enough to conserve battery drain.

When the switch S4 (CB contacts closed) transfers to the ECM it sends power to the drive

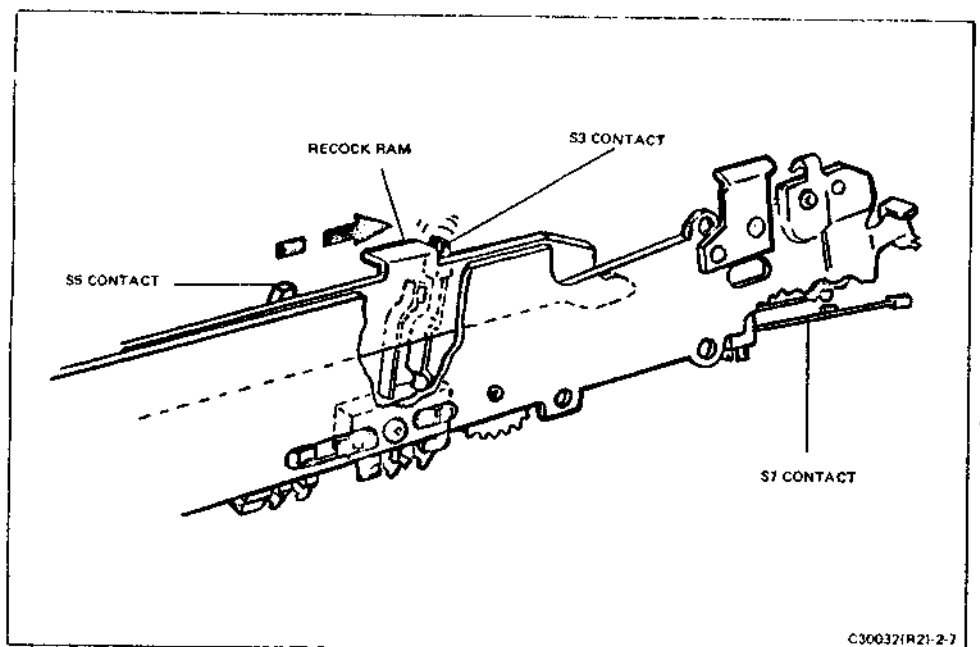


FIGURE 2-7 S3 BEING OPENED BY RECOCK RAM

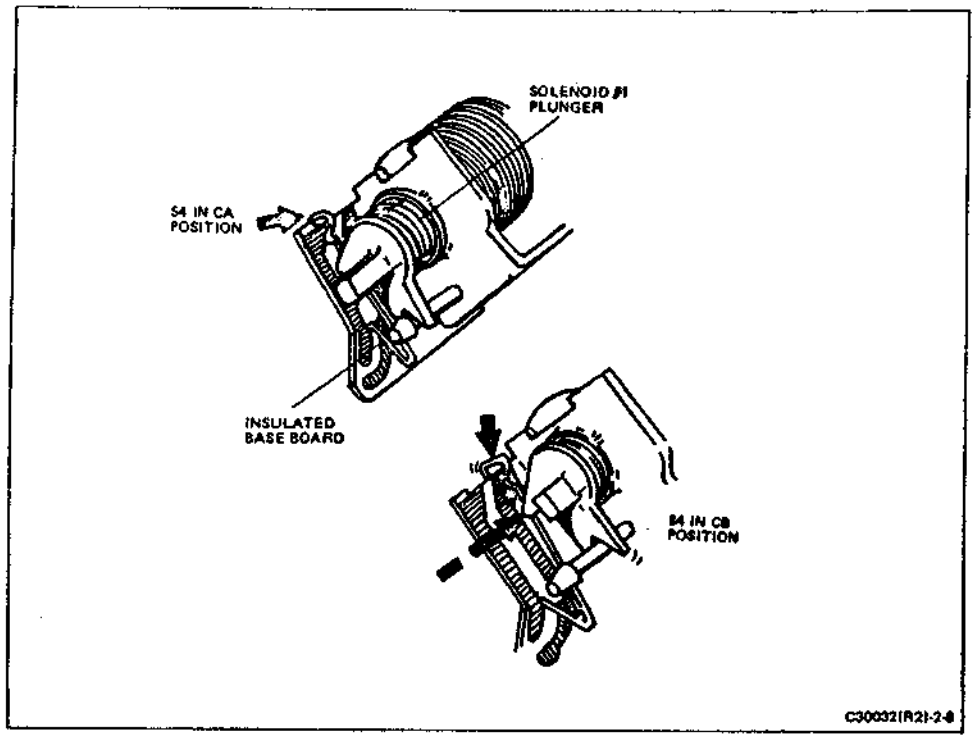


FIGURE 2-8 S4 SWITCH OPERATING CONFIGURATIONS

motor and operates the gear train. When S4 is actuated, (CB contacts closed) it also disconnects power from the FFA flash circuitry. This action prevents damage to the circuit in the event that a flashbulb becomes short-circuited after it is fired.

e. Switch S5 (normally closed at the beginning of the exposure cycle), like S3, is located in the gear train and actuated by the recock ram (Figure 2-7). When the gear train rotates to the appropriate point in its cycle, S5 opens and removes power from the drive motor, applying dynamic braking voltage to stop the gear train quickly. The ECM reacts to this command in such a way that the exposure cycle continues completion even though the operator has released the exposure button (S1). After exposure and when the fresnel carrier returns to the viewing position, S5 is closed by the recock ram and stops the camera cycle.

f. Switch S6 is closed by opening the camera to the picture-taking position. It disconnects the negative side of the battery from the common return (ground) when the camera is folded to assure the removal of power from the circuit.

g. Switch S7 is closed when the front cover is closed. It is wired in series with S6. Like S6, S7 disconnects the negative side of the battery from the common return so that the camera cannot function until the front cover is closed and latched. It is an interlock during normal picture-taking. With S6 and S8 closed, it initiates the dark slide function.

h. Switch S8 (Figure 2-8A) is part of the exposure counter operated by the counter wheel. As S7 closes, power is applied, ejecting the dark slide. After dark slide ejection, the counter wheel turns, opening S8. S8 then remains open until the film pack is removed. When the pack is taken out, S8 closes.

i. Switch S9 is near S8 on the exposure counter assembly. When the counter reaches the 0 position, switch S9 closes and the ECM inhibits the flash-firing function, so that if an unused bulb is still available it will not be wasted.

j. For a handy summary, see the Switch Function Table.

3. Function Sequence

The following paragraphs describe the sequence in which the switches operate during normal operation of the camera.

a. The operator opens the camera. Switch S6 connects the battery to the camera circuitry.

b. The operator opens the front cover. Switch S7 opens and removes battery power from the camera.

c. The operator inserts a film pack. (When the previously used film pack was removed, a mechanical coupling device set the exposure counter to the position just before the first exposure and closed S8, but since S7 has removed all battery power no action occurs.)

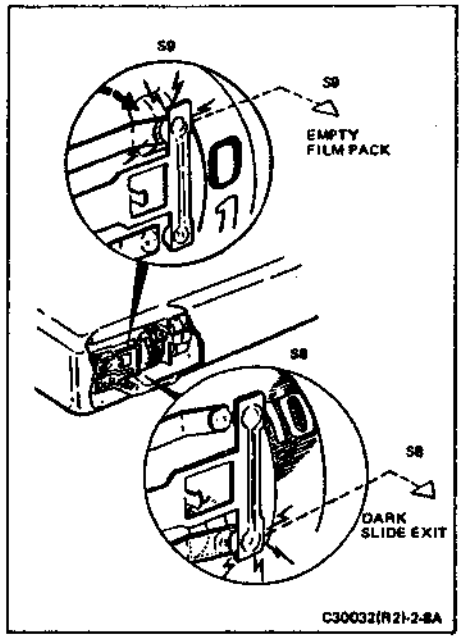


FIGURE 2-8A S8-S9 EXPOSURE COUNTER SWITCHES

SWITCH FUNCTION TABLE

Switch	Action	Result
1	Closes	Initiates exposure cycle and causes circuitry to take and deliver the picture.
2	Closes	Connects circuitry to take flash pictures.
3	Opens	Initiates "Y", 40 millisecond delay. (Power down solenoid #2 in the flash mode.)
4	CA Closes	Controls power to solenoid #1 (drops current to holding level).
	CB Closes	Signals the ECM to start the motor.
5	Opens/Closes	Stops motor both by closing and opening depending upon sequence of action and internal circuitry.
6	Closes	• Connects the battery to the electronic circuitry when the camera is opened for use.
	Opens	• When camera closed, cuts power from battery.
7	Closes	When S8 is also closed, it provides power to the camera when the front power is latched (for dark slide eject). Also acts as an interlock during normal picture taking.
8	Closes	Enables (with S7 closed) the circuitry to eject dark slide. Opens again after the dark slide is ejected.
9	Closes	Prevents firing flash if film pack counter is on "0".

d. The operator closes and latches the front cover. S7 closes, power is applied and the camera ejects the dark slide.

NOTE: During this action (and in certain other operations) other switches actuate and functions occur but, unless they contribute to the particular camera function being described, they are omitted from this discussion.

The counter indicates exposure #10 (and opens S8) thereby showing that the camera is ready to take the first picture.

e. The operator aims, focuses the lens, and presses the red shutter release button (S1). The ECM actuates solenoid #1 which closes the shutter blades. Solenoid #1 transfers the S4 contacts from CA to CB, which in turn, switches the circuit from full solenoid power to holding current (power-down). Closing contacts CB of switch S4 also starts the drive motor. Opening S4 (CA) removes power from the FFA.

f. As the gear train runs, it mechanically releases the spring-loaded fresnel carrier so that it leaves the film plane and rises to its exposure position. This is accomplished by the mirror release cam of the recock gear. The recock ram falls off the recock cam, allowing the ram to snap forward. This allows the drive spring to raise the fresnel assembly to the exposure mode. The ram also moves away from S5 allowing S5 to open. This action causes the ECM to dynamically brake the motor which will remain at rest throughout the exposure segment of the cycle. The S5 switch action also programs the ECM to complete the cycle even though the operator has released the exposure button after S5 is open.

NOTE: There would appear to be a contradiction between this step and step j-10 below wherein closing of S5 performs the identical function, i.e., stops the motor and applies braking. S5 is able to perform in this manner, however, because the circuit (gate) to which it is connected, is in a different condition during each of the steps.

g. While the fresnel carrier was moving up prior to motor shutdown, the recock ram opens switch S3. When S3 opens, it signals the ECM to initiate a 40-millisecond delay in the sequence. This amount of time prevents a picture from being taken until mirror bounce has subsided.

h. At the end of the 40 millisecond delay period, the ECM removes power from solenoid #1 and the shutter opens. Simultaneously, the circuit starts timing the exposure (integration). The integration components of the ECM are controlled by the amount of light received by the photocell. At this same time, the flash delay section of the ECM is made ready but will not function unless a flashbar has been plugged in, to close switch S2.

i. When power is removed from solenoid #1 (and the shutter begins opening), the actuator on the plunger returns switch S4 to its original condition (CA closed). When the exposure timing cycle is complete, power is returned to solenoid #1 and the shutter closes, opening CA, closing CB, placing solenoid #1 again in the power down condition and starting the motor to eject the exposed film.

NOTE: The length of the timing cycle is determined by the amount of light reaching the photocell. If there is insufficient light to correctly operate the integration circuits, the system will automatically terminate the exposure within 14 to 30 seconds.

j. When, in the previous step, the solenoid closes the shutter blades and the drive motor is energized, the gear train resumes its sequence with the following results:

1. The film pick feeds the exposed film to the spread rolls.
2. At the end of its travel the pick is held in its forward position by the pick latch.
3. Film moves through the spread system.
4. The recock gear cam proceeds to return the recock ram which, through the bell crank, moves the fresnel carrier down.
5. The recock ram closes switch S3 to prepare for another exposure.
6. The light stop opens the optical path to the viewfinder.
7. The film completes its passage through the spread rollers. The front cover idler gear meshing with the gear train powers the top roller which drives the film through the exit slot.
8. The fresnel carrier when fully seated is held by the recock ram.
9. The pick latch releases the pick and the pick returns to its starting position.
10. The recock ram closes S5 to cause the ECM to shut off and dynamically brake the drive motor.

k. If the operator has removed pressure from the exposure button all power will be removed and the shutter blades will open to permit viewing. If the button has not been released, the shutter blades will remain closed until the operator removes his finger from the button.

l. When a flash bar is placed in its socket, it closes switch S2. This switch connects the ECM in the flash mode. All of the mechanical sequences will remain as just described. The ECM however, will now provide power to solenoid #2 when switch S5 (in the gear train) opens, and will maintain it in a power down condition when S3 opens.

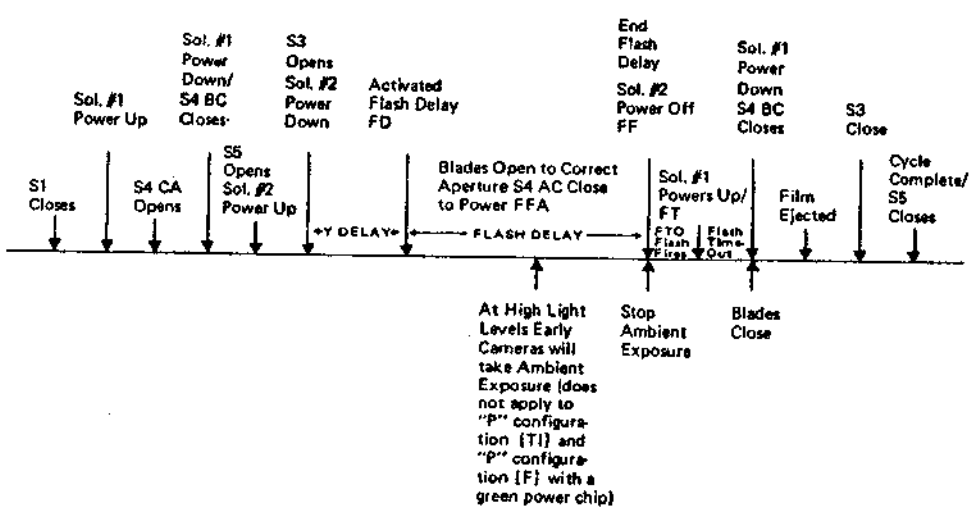
m. Within the shutter assembly a cam follower is driven by a cam on the focus wheel and arranged so that it will mechanically stop the travel of the shutter blades relative to the focus distance. When solenoid #2 is not energized, a spring on the cam follower prevents engagement of the cam follower and the shutter mechanism functions in the ambient exposure mode. When the ECM is programmed for flash, solenoid #2 is energized and the shutter opening is controlled by focusing distance.

n. When making a flash exposure and the shutter blades start to open, the interceptor will be set to a position determined by the focusing mechanism but out of the path of the interceptor pin. When solenoid #2 is energized, it pulls the interceptor into the pins path of the blades and stops them at the aperture for flash exposure at the set distance (Figure 1-13). The interceptor latches in this position. At this time, the ECM removes the power from solenoid #2. The solenoid, like any inductive device, produces a flyback voltage when its magnetic field collapses. This flyback voltage is used to trigger the ECM which, in turn, applies power to the FFA to ignite the next unused flashbulb.

o. The shutter performs an additional function in the flash mode. One of its circuits examines the #1 flash bulb contacts and by virtue of the resistance determines whether or not the bulb has been fired. If the #1 lamp is exhausted, the circuit scans to #2, etc. When an unused lamp is located, the firing circuit remains connected to the lamp until it is used.

NOTE: It is important to be aware that in early cameras the timing (integration) circuits of the substrate continue to function even though the insertion of a flash array has placed the substrate in the flash mode. Thus, if the ambient light level is high, the picture may be made by ambient light without firing the flash. Also, if all the flashlamps are expended and a picture is taken, an ambient-light exposure will result. The photographer will recognize this situation by the absence of a flash. However, he may still get an acceptable picture. The aperture in this case will be determined by the flash-to-subject distance.

FLASH TIMING SEQUENCE CHART


Sol. #1 Power Up
Sol. #1 Power Down/ S4 BC Closes
S3 Opens Sol. #2 Power Down
Activated Flash Delay FD
End Flash Delay
Sol. #2 Power Off FF
Sol. #1 Power Down S4 BC Closes
S3 Close
S1 Closes
S4 CA Opens
S5 Opens Sol. #2 Power Up
FD DELAY
Blades Open to Correct Aperture S4 AC Close to Power FFA
FLASH DELAY
Sol. #1 Powers Up/ FT
FTO Flash Fires
Flash Time-Out
Film Ejected
Cycle Complete/ S5 Closes
At High Light Levels Early Cameras will take Ambient Exposure (does not apply to "P" configuration (T1) and "P" configuration (F) with a green power chip)
Stop Ambient Exposure
Blades Close

F. SHUTTER MECHANICAL DETAILS (Figure 2-9)

The following paragraphs describe the manner in which the mechanical components of the shutter respond to either manual or electrical direction.

1. When the operator prepares to take a picture, he first must aim and focus the camera. As he rotates the focus wheel to bring the split fresnel image into focus, a cam molded into the rear surface of the focus wheel moves the component identified as the cam follower assembly. The trim link coupled to the trim assembly is pinned to the cam follower in such a way that follower movement is also directly influenced by the setting of the trim wheel. (The trim wheel is the lighten/darken control on the photocell.)

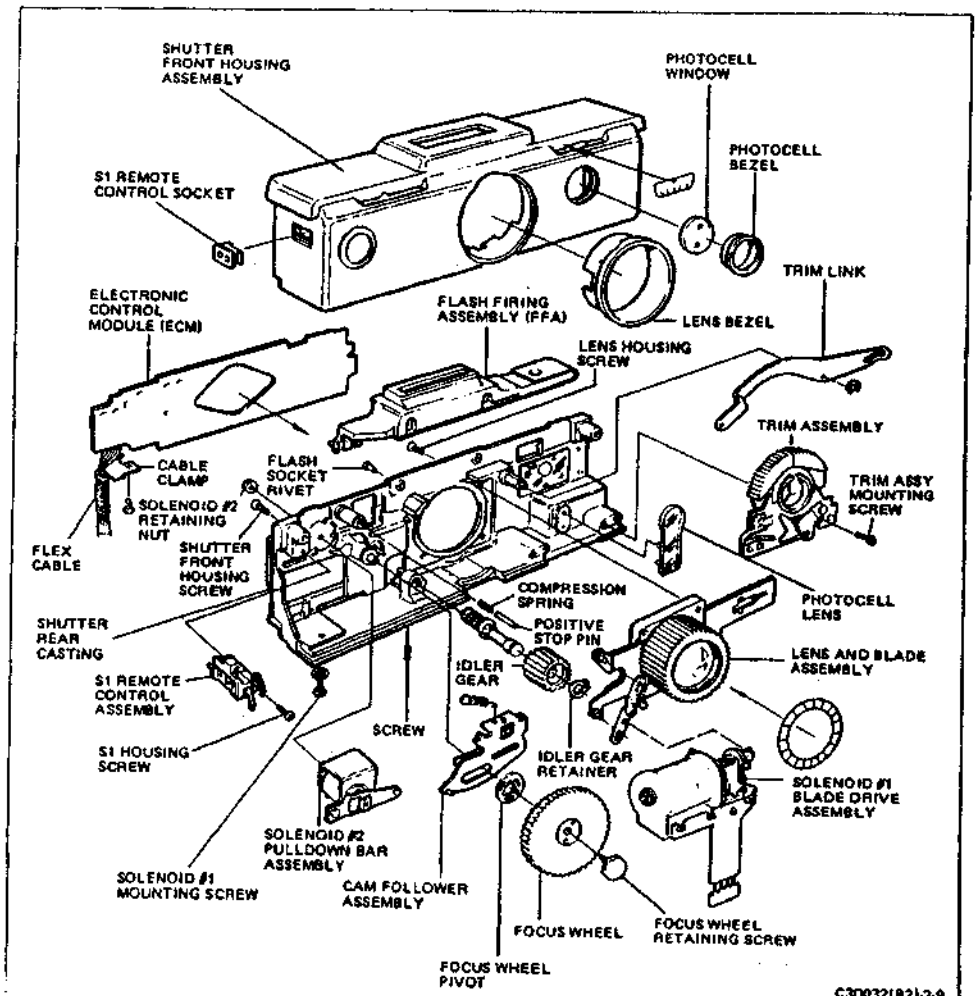


FIGURE 2-9 SHUTTER, EXPLODED VIEW

2. When an ambient-light exposure is being made, all of the action just described takes place but does not affect the shutter action. However, when a flash array is inserted switch S2 in the flash socket programs the electronics to energize solenoid #2. The impact of this action on the movement of the shutter blades is described in paragraph F4 but first the shutter blade actuation must be described as follows:

3. When the ECM circuit powers solenoid #1, the solenoid plunger is pulled into its seat, overcoming the opening spring force. The plunger pulls the walking beam, rotating it about 60 degrees.

   Each of the shutter blades has a pin which engages a slot in the walking beam. As the walking beam rotates, it transmits its rotary motion to the shutter pins and drives the rear blade to the right (facing the front of the shutter) and the front blade to the left thus closing the light path of the picture taking lens and the light path of the photocell lens. When the shutter is totally closed and the gear train has reached the point in the sequence at which the fresnel carrier snaps up, the exposure sequence starts. The blades will proceed toward the fully open position and return to a closed position in the time interval dictated by the photocell and integrating circuit. The blades may not reach the fully open condition if the illumination level is high, or they may fully open and remain open for a period of time if the light level is low. If a flash array is mounted, the blades may not be permitted to open completely because of the follow-focus mechanism described in part in the foregoing paragraph. The following paragraph explains the interaction of the follow-focus components and the shutter blades.

4. Installing a flash bar in the camera flash socket switches the ECM to the flash mode. As previously explained, at a point in the picture taking sequence (flash mode), solenoid #2 is energized. Fastened to the plunger is the pull down bar. When the plunger pulls this bar down, it moves the interceptor into the position where it will intercept a pin (the stop pin) on the walking beam (Figure 2-9A). Now when the shutter blades move towards the open position, they will be interrupted by the mechanism just described which means that the maximum size of the blade opening (aperture) is determined by the focus setting of the camera. As the camera (and thus the flash lamp) is moved closer to the subject, the maximum aperture is reduced so that a correct exposure will result. The reverse (greater distance/greater aperture) is also true.

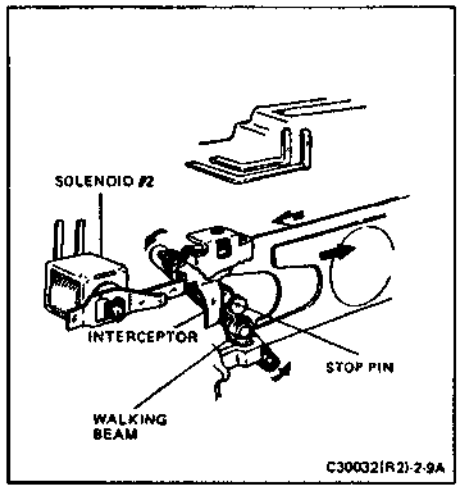


FIGURE 2-9A SOLENOID S2 OPERATION

5. The shape of the pin on the walking beam is such that once contacted by the cam interceptor it remains latched in that position until solenoid #1 is actuated during the next phase of the shutter cycle. When the plunger on solenoid #1 pulls in, the follow-focus pin disengages from the interceptor and the solenoid #2 plunger returns to it original position under the force of the interceptor hinge spring.

6. Since the photocell components are contained within the shutter housing, they are included in this discussion. A lens is employed to focus the reflected light from the subject on the photocell. A second pair of openings in the shutter blades control the amount of light received by the cell as previously described. A variable neutral-density wedge system is employed to provide lighten/darken adjustments (Trim Assembly). The operation of this control differs slightly from those used on other Polaroid cameras. When the camera is folded, a cam on the light shield of the front cover strikes a release lever on the lighten/darken assembly and returns the trim adjusting wheel to its center (normal) position. The trim wheel is automatically centered when the camera is closed.

7. To compensate for any variations in individual photocell characteristics, a neutral-density filter is selected and installed in front of the photocell lens during assembly. A calibration must be performed and a filter of correct density installed any time the ECM requires replacement.

G. FILM PROCESSING COMPONENTS

The basic theory of the film processing method remains unchanged from previous Polaroid systems. That is, the developing chemistry is encapsulated in a pod on each sheet of film and, as the sheet is passed between rollers, the pod is burst and the chemical spread evenly between the negative and the mylar protective cover. Except for these characteristics, no direct similarities exist. The SX-70 camera employs a unique process which totally eliminates the "throw-away" negative. The print is drawn through the spread rolls by the motor drive system so that no action need be taken by the operator. See Figure 2-10. Development takes place outside of the camera and is unaffected by ambient light conditions. Since the end result is determined when the picture emerges from the camera, no time measurement is necessary. (Additional film information is available on pages 60 and 61 of "The World of SX-70".)

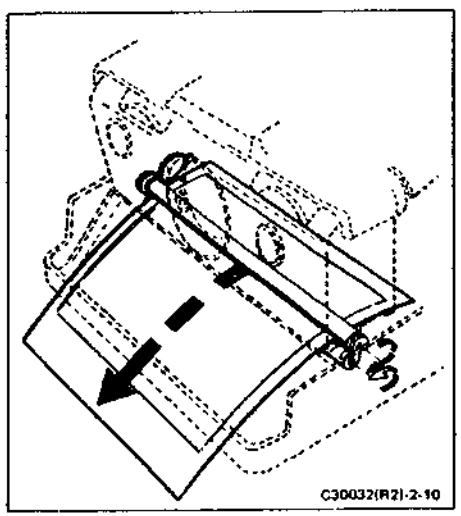


FIGURE 2-10 SPREAD ROLLER SYSTEM

H. SEQUENCE OF OPERATIONS

The operator pushes S1, applying full power to solenoid #1, which closes the shutter blades, and pushed solenoid #1 against S4, changing it from CA to CB. Closing CB cuts solenoid #1's power from high to low; low is enough to hold the blades closed. Closing CB also signals the ECM to start the motor.

The motor starts the gear train moving. The movement of a cam on the gear train releases the recock ram and, through spring action, raises the fresnel carrier. When the recock ram moves, it opens S5 and then S3 at certain fresnel carrier angles. Opening S5 stops the motor after it has made only a brief jog. Opening S3 starts the Y-delay; a 40-millisecond delay which allows the fresnel carrier to come to rest after its travel. (This eliminates bouncing caused by the sudden stop of the carrier on the mirror cover.)

At the end of the Y delay, power is removed from solenoid #1, allowing the spring to open the shutter for exposure, and moving S4 from CB to CA position. When the proper exposure level is reached, the photocell trips the Schmitt Trigger (S/T) in the ECM which sends full power to solenoid #1. This closes the blades and transfers S4 from CA to CB. As before, closing CB cuts solenoid #1's power from full to low, sufficient to hold the blades closed; closing CB also signals the electronics to start the motor.

The motor starts the gear train again, and this time the cams cause a series of actions at different positions of gear train movement:

- it starts the pick which pulls the film into the rollers (one of which is attached to gear train – it is this powered roller rotation that pulls the film through and out of the camera);
- it stops the pick;
- it pulls down the fresnel carrier, which in turn, moves the counter to the next number;
- it moves the recock ram, closing S3 (resetting it for the next cycle);
- it returns the pick;
- it seats the fresnel carrier so it is ready for the next cycle;
- it moves the recock ram, closing S5, which stops the motor;
- and it stops the spread action.

When S5 closes, it cuts power to the solenoid #1; the spring opens the shutter blades, and S4 is pushed from CB to CA. (The blades open only if the operator releases the red button.) The system is ready for a new exposure cycle.

Springs are used in three of the operations discussed above: holds the shutter blades open, flips the fresnel carrier up, and holds the pick at the rest position.

As indicated, inserting a film pack causes automatic action. This could, of course, be a partial pack: the top sheet of film would be ejected as a dark slide and the counter would register "10". After the last actual sheet is used, the camera would still function until "0" is reached. If a flash bar were attached,

and an unused bulb was available after the last film sheet was used, attempting to make another exposure would fire the flash.

The differences in the flash mode are:

Inserting a flash bar closes S2, which activates solenoid #2 to move the interceptor into position. This controls the shutter blades according to focusing: the closer the subject the more light from the flash will bounce back. Therefore, the smaller the permitted aperture.

At the end of the Y-delay, a flash delay circuit is activated, and when S4 switches from CB to CA, CA sends power to the flash circuit. During the fixed flash delay, the photocell and S/T are operative, so that if enough light energy is collected before the end of the flash delay, the blades will be closed as in the ambeint picture. However, on newer cameras ("P" configuration shutters), the flash will fire whether or not sufficient ambient light is available.

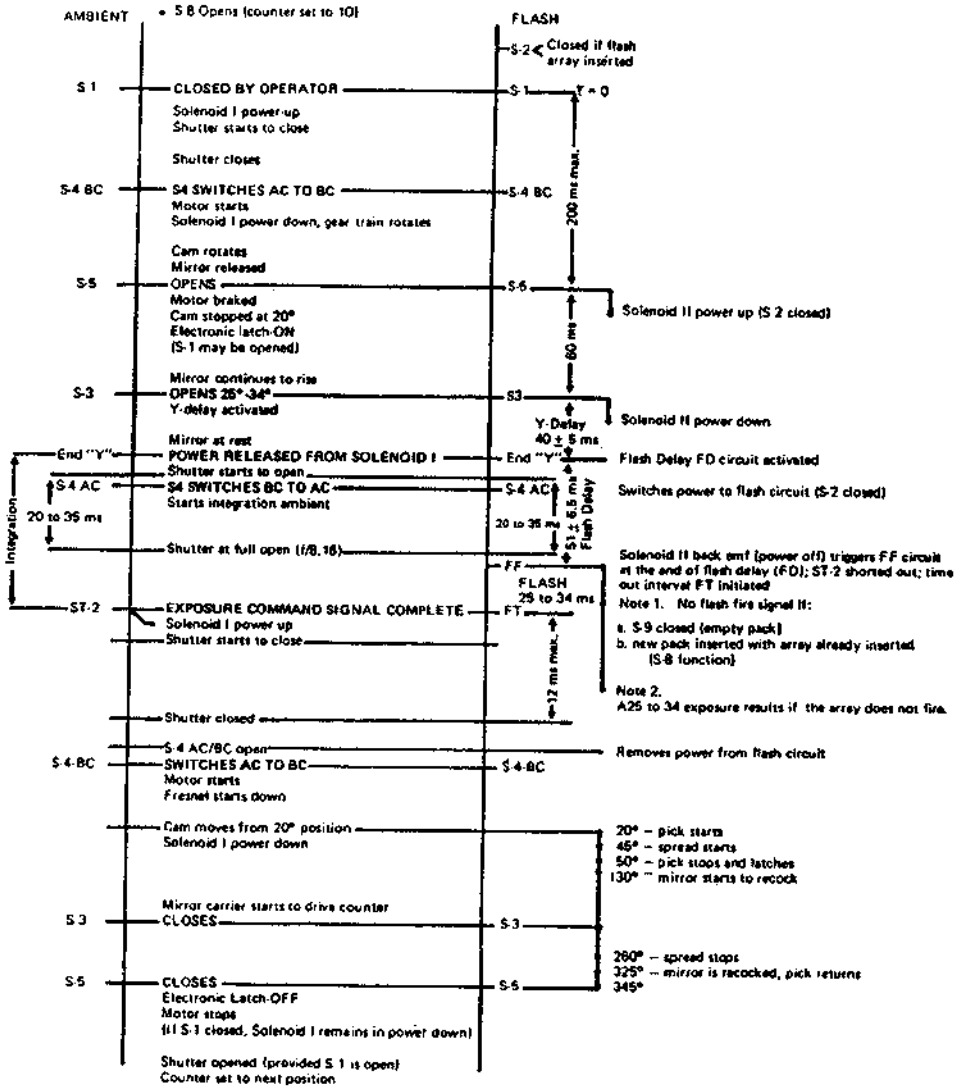
At the end of the flash delay (the blades at this point are open to the aperture dictated by focusing) power is removed from solenoid #2 and the discharge (flyback voltage) triggers the flash circuit, firing the flash and starting the flash time-out interval (the fixed exposure time). If, on early cameras, an ambient exposure has been made, S/T-2 in the ECM receives the signal and no flash or flash time-out occurs.

At the end of the flash time-out, the circuitry energizes solenoid #1 which closes the blades. If no flash has occured, caused by all the bulbs having been used, no signal will be sent to solenond #1, and on early cameras an ambient exposure will be made. If the S/T has not collected sufficient light energy at the end of a fixed period (20 seconds), the blades will automatically close. On newer cameras, the exposure time remains short and a black picture will result.

EXPOSURE/PROCESS
OPERATION SEQUENCE

Spec. No. 2180
Issue 2

- S-9 Opens when previous pack removed
- S-6 Closed during the erecting mode
- S-8 Closed until film cover ejected
- Gears between front cover and gear train mesh as cover closes (3rd & 4th idler)
- S-7 Closes during front cover closure, resulting in dark slide ejection after a new pack is inserted



III - TROUBLESHOOTING

A. INTRODUCTION

The SX-70 camera is an electronically controlled device, the electronics being in the integrated circuits (IC) mounted in the Electronic Control Moduel (ECM) and Flash Fire Assembly (FFA) in the shutter housing and in the Motor Control Circuit (MCC) in the camera back. Because the IC's are non-repairable items, there is no requirement to trace faults within the integrated circuits. It is mandatory, however, to be able to identify the command inputs (switches open or closed, etc.) and the resulting output signals. The SX-70 Comprehensive Tester provides the readouts necessary to confirm an exposure malfunction; but a thorough understanding of the theory of operation is required if meaningful use of the tester is expected. If a particular camera function fails, it is necessary to recognize how the failure is related to the operating sequence of events and thus reduce testing procedures to those related to the area of malfunction.

Because of the camera's total automation, it is unlikely that much useful guidance can be obtained from customer complaints except in cases of visible mechanical damage. For this reason, a well-defined series of checks, observations, and tests must be followed. This section of the manual defines these procedures.

The primary purpose of any fault analysis program is to reduce the investigation time to a minimum. Thus, it is not only important to establish a fixed routine, but it is mandatory to acquire the maximum amount of information from each step of the checkout procedure. Use the charts at the end of this scetion to guide you through each step of inspection, dynamic testing and post-repair tests.

Analysis of the SX-70 camera is a key part of the complete repair task. If the analysis is done correctly, it will eliminate excessive repair time and high parts replacement cost. For instance, initial evaluation may show the entire shutter to be at fault; however, continuing analysis determines that the problem is in solenoid 2, which, when replaced reduces the material cost considerably (from over $20.00 to under $2.00). The repair person must always consider the labor vs. material trade-off when making a repair.

B. INITIAL TESTS

Do not make any arbitrary assumptions. An assembly or component should be thoroughly tested to determine whether or not it is performing its function correctly. Complete the tests in the chart below.

SX-70 CAMERA REPAIR INSPECTION PROCEDURE

A. FUNCTIONAL TEST

1. Perform light leak test.
2. Check focus and trim wheel torque.
3. Check trim wheel reset ±2 teeth and front cover to shutter gap.
4. Cycle camera 3 times at 5.0 and 6.4 volts with power pack.
5. Focus camera at 8' – perform aperture test (see specification sheet).
6. Ambient mode tracking at 3 light levels (note current drain) (see specification sheet).
7. Collimate at infinity.
8. Flash mode tracking at 10.4". (See specification sheet.)
9. Check flash system.
   a. Flash sequence (with camera tester) check counter rotation.
   b. Flash on zero.
10. Inner frame bow (+.004 to +.011).

B. OPERATIONAL SEQUENCE

1. Check camera latching.
2. Erecting link (grinding).
3. Positive lock.
4. Check front cover movement and latch.
   a. Check trim reset cam (correct cam and condition).
   b. Light shield (condition and movement).
   c. Light piping seal.
   d. Idler gear staking.
   e. Output gear slippage.
5. Check flash on dark slide with power pack and flash simulator.
6. Take flash pix at 10.4", check premature dark slide.
7. Check for dirty rollers and film catcher spring.

C. FINAL VISUAL

1. Check optical path.
2. Fresnel cosmetics (per standards chart). Split image.
3. Wafer and 3° eye lens.
4. Entrance and exit pupil position.

D. SHUTTER COSMETICS

1. Chrome
2. Lens condition.
3. S-1 button and photocell condition – trim wheel decal.
4. S-1 remote and flash socket condition.
5. Shutter mounting screws (missing or loose).

E. CAMERA BACK

1. Shade blade condition (scratches – distorted).
2. Shade blade movement (gap between blades).
3. Concave mirror condition (color code refurbished only).
4. Repair techs scribe (data and repair center code).
5. Gear train cover.
6. Bottom cover window and condition.
7. Cable cover – cable clamp – cable restrainer (condition – position).
8. Cable spring hook on.
9. Boot retainer tabs in place.
10. Cracked/broken hinges.
11. Shutter hinge bracket pivots and gap (.0125 max.).
12. Leather and chrome cosmetics.
13. Set lens at infinity.

F. PICTURE EVALUATION

1. Baffle in pix area.
2. Cracked/dirty taking mirror.
3. Incomplete coverage (front cover related).
4. Color code and FTC label (refurbished cameras only).

**If camera is classified as "checks ok" – cycle camera 12 times at 4.7 and 6.6 volts in both flash and ambient modes (total 48 cycles).*

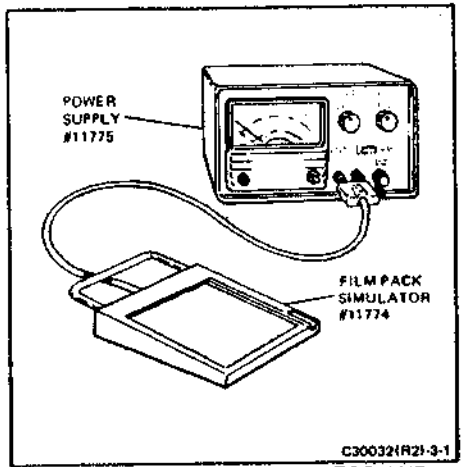


FIGURE 3-1 FILM PACK SIMULATOR AND POWER SUPPLY

C. TEST EQUIPMENT OPERATION

Checkout of the SX-70 camera requires the use of several pieces of test equipment. The purpose of this section is to instruct you in the proper use of this equipment.

1. Power Supply and Pack Simulator (Figure 3-1)

In use, the system substitutes for the film pack, giving a steady, reliable source of power.

a. Plug the pack simulator into the power supply being careful to observe polarity (ground is negative).

b. Set the power supply switch to VOLTS and turn the supply ON.

c. Adjust the output to the desired voltage (5.8v normal).

NOTE: Except on Lafayette-made units, the power supply meter is not adequate to set the voltage. Use an external meter (VOM or VTVM) to make this setting.

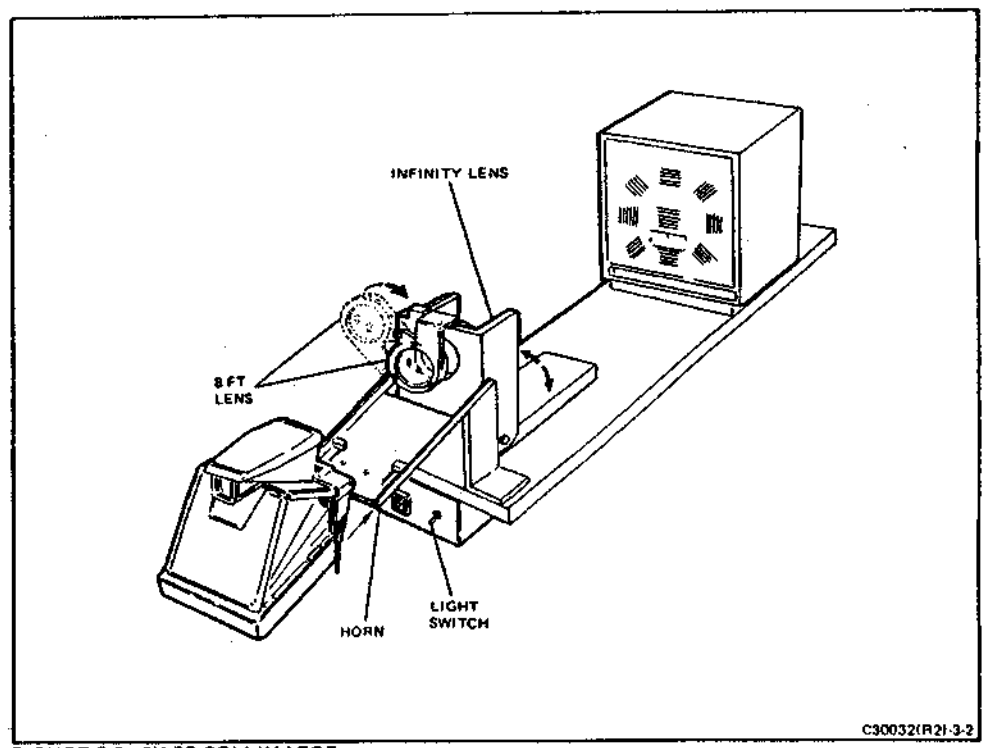


FIGURE 3-2 SX-70 COLLIMATOR

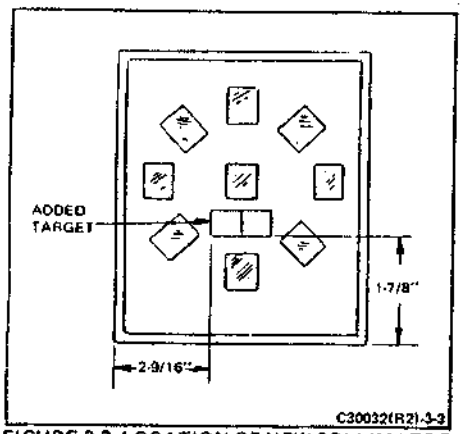


FIGURE 3-3 LOCATION OF NEW COLLIMATOR TARGET

d. Set the power supply switch to the AMPS position.

e. Remove front cover from camera.

f. Insert the pack simulator into the camera as you would a film pack (with the contacts down). Close the camera S7 switch using the actuator.

2. Collimator (Figure 3-2)

When performing several of the Comprehensive Tester checks, a requirement of the test is that the camera lens be correctly collimated. For this reason and because the lens can be checked simply and rapidly, the collimation checks should be done before Comprehensive Tester checks. Collimation for the SX-70 camera is done on the special collimator as indicated below.

a. Collimation of a Split Image Viewing System

NOTE: If the collimator is not available, set the focus wheel to infinity and look at a scene at least 200 feet away. Observe that the focus is sharp within a tolerance of -1 tooth to +2 teeth beyond the infinity setting of the focus wheel.

NOTE: If an early vintage collimator is being used, a new adhesive-backed label must be added to the target in the position shown in Figure 3-3.

(1) Remove the camera front cover and load the camera onto the horn of the collimator #321564 (Figure 3-2). (The collimator uses a rear-illuminated target so no additional equipment is needed.)

(2) Turn on the collimator light.

(3) View the added target with the focus wheel set to infinity.

(4) Compare the observed conditions with the examples shown in Figure 3-4. As indicated (best case), the upper part of the vertical line should be aligned with the bottom part of the line or it may be displaced to the right. (If displaced to the right (acceptable), it should still be touching the lower part of the line.)

(5) If the upper part of the line is displaced to the right so far that it does not touch the lower part of the line or if it is displaced to the left (out of tolerance), the tolerance levels are exceeded and the camera must be rejected. Corrective procedures are outlined in Section 4.

b. Collimation of Non-Split Image Viewing System

(1) Turn on the collimator light source.

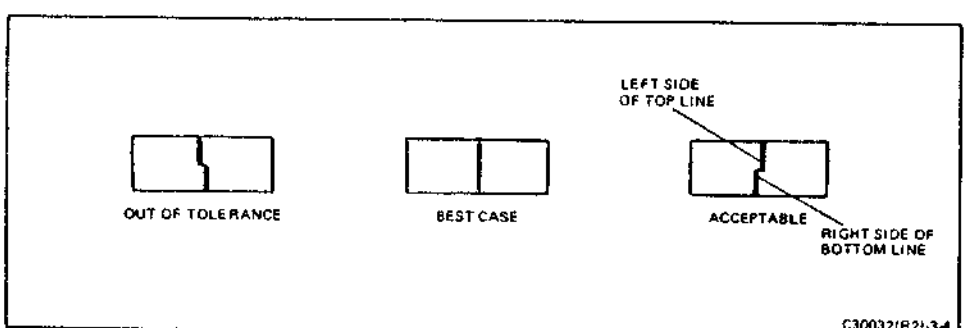


FIGURE 3-4 TYPICAL COLLIMATION CONDITIONS

(2) Open the camera front cover and slide the camera onto the horn of the collimator. Make sure that the camera is all the way on the horn so that the camera is captured by the spring latches.

(3) Swing the collimator infinity lens to its vertical position. (Be sure the 8' lens is not in the viewing path.)

(4) Look into the camera viewfinder while turning the focus wheel counterclockwise until the image appears sharp. Look at the collimator center target (top group of lines) and note the number .63. This number and the lines should have maximum clarity as the focusing wheel reaches infinity.

(5) If the wheel stops before the focus is sharp, make the following adjustment before continuing with the collimation procedure.

Spring-Loaded Idler Gears

(a) With the camera still on the collimator, slip special tool #11939 over the lens and push it in, toward the back of the camera. This will disengage the idler gear from the focus wheel, allowing the lens to be turned without affecting the focus wheel.

(b) With the focus wheel still set at its infinity position, look through the camera while turning the lens. (This is done by maintaining pressure on the tool.) While turning it, you will be able to see the target through the opening in the tool.

(c) When the image is sharpest, release the special tool to reengage the refocused lens to the focus wheel. (Continue with step 6.)

Non Spring-Loaded Idler Gears (Earlier Cameras)

(a) Remove the camera from the collimator.

(b) Loosen the adjusting screw at the bottom of the shutter housing so the idler gear no longer engages the focus wheel and lens barrel (Figure 3-5).

(c) Return the camera to the collimator and adjust the infinity focus by rotating the lens barrel while maintaining the infinity position on the focus wheel.

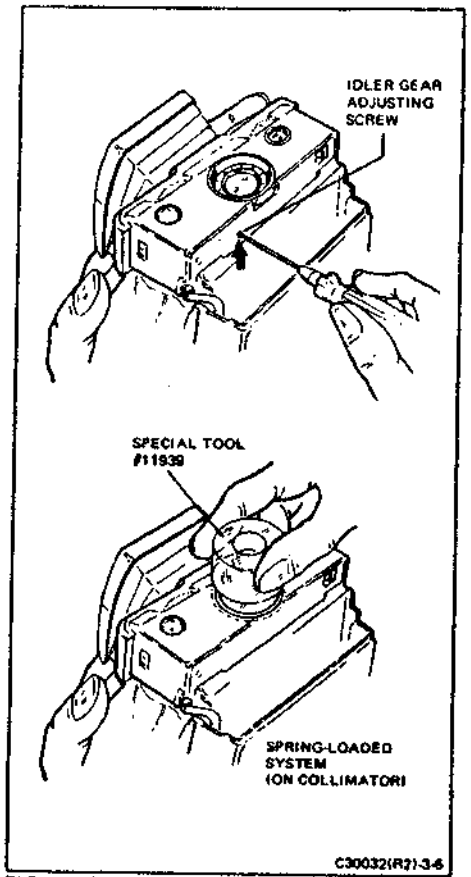


FIGURE 3-5 DISENGAGING THE IDLER GEAR

(d) When the focus is sharpest, remove the camera from the collimator and tighten the adjusting screw. Return the camera to the collimator and continue with step 6.

(6) Verify the infinity setting. Do this by observing the vertical line target through the collimator infinity lens and the camera optics. The line should be straight within the tolerance shown in Figure 3-4.

(7) Swing the collimator infinity lens back down to its horizontal position, out of the viewing path of the camera. Turn the camera focus wheel to the 10.4" setting.

(8) Look through the camera and observe the vertical line target. Compare the observed image with Figure 3-4 to determine if the camera is within specifications.

NOTE: There is no separate close-focus adjustment on the camera. If the focus wheel has reached its stop before maximum resolution is achieved, return to the infinity check. If there is any tolerance at that setting, readjust the infinity setting as close as possible to the focus-wheel stopping point and recheck the close focus. If it is still impossible to obtain a sharp image, the lens is defective and the shutter must be replaced.

NOTE: The foregoing tests assume that when the camera is operated, the viewing mirror (Fresnel carrier) reaches the correct attitude during the exposure cycle. If the lens has been correctly collimated, the only check possible of actual picture definition is to expose a film.

3. Comprehensive Testers (Figure 3-6 and 3-7)

There are two models of Comprehensive Testers available for semi-automatic testing of the SX-70 camera. The earlier model, Comprehensive Tester Model A, consists of three interrelated units; the lightbox, the electronics module, and the power supply (Figure 3-6). Comprehensive Tester Model B (Figure 3-7) also consists of three interrelated units; the Comparalumen calibrated light source, the electronics module, and the mounting horn or holding fixture. The purpose of both tester models is to check the dynamic operating functions of the camera. (A detailed description of the later tester is available in a technical manual titled "Model 'B' Camera Tester". This section will deal only with the operating instructions for the tester.)

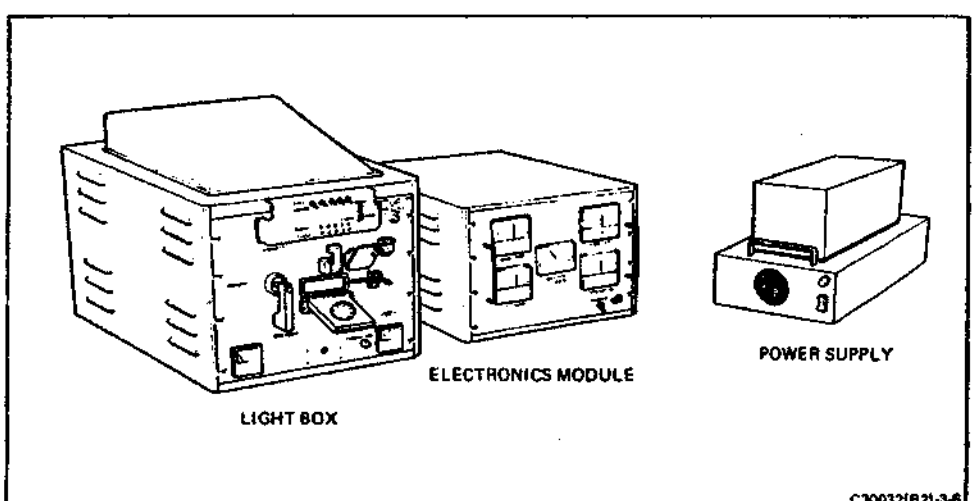


FIGURE 3-6 COMPREHENSIVE TESTER

MODEL A CAMERA TESTER

a. Set-Up

Before testing the camera, perform the following set-up procedure.

(1) Calibrate the tester daily. Record the calibration readings in a log. (If the test equipment is suspected of poor performance, calibrate more frequently and repair if necessary.)

(2) Remove the front cover from the camera.

(3) Set the L/D control to the mid-range position using the trim reset cam and focus the camera at infinity.

(4) Using the S7 actuator, close the S7 switch.

(5) Allow the tester to warm up for a period of 30 minutes.

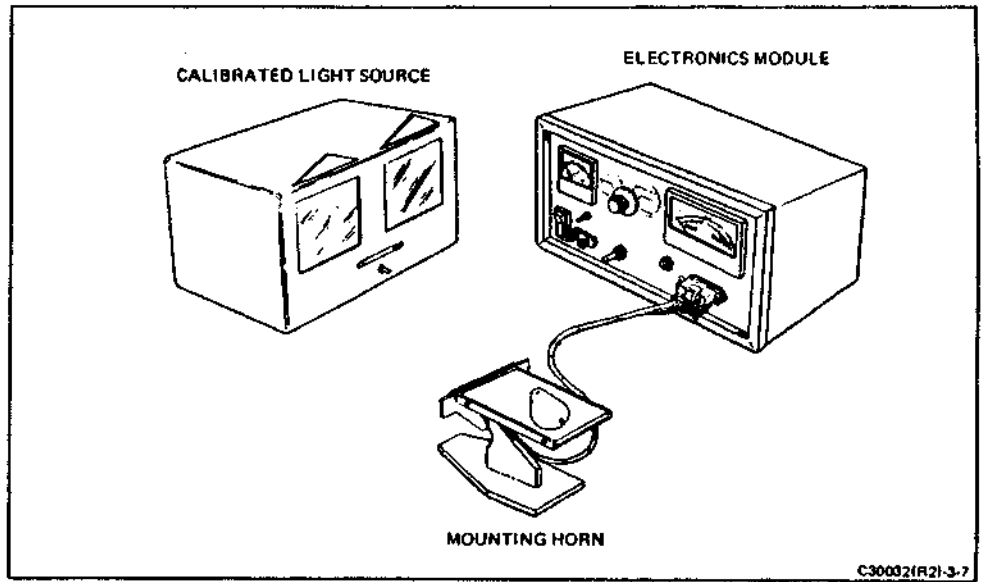


FIGURE 3-7 MODEL B CAMERA TESTER

b. Ambient Mode Exposure Test

(1) Place the S2 switch in the OPEN position. Set voltage to 5.8 volts.

(2) Set the light level selector to the desired 100 light level.

(3) Slide the camera over the horn on the tester. The camera should go through the dark slide (S8) cycle. If not, remove the camera from the horn, determine the cause of failure, and correct the dark slide operation. If the camera cycles correctly, push the simulator flash plug all the way down into the flash socket.

(4) Read the current meter – it should read "0" after the dark slide cycle.

(5) Press the exposure button and hold it down while observing the exposure meter. The readings must compare to the specifications shown in the Standards paragraph at the end of this section. (When the exposure button is released, the meters will automatically reset.)

(6) Observe the BATTERY DRAIN meter. The reading should be according to specifications. This test applies only to the first exposure of a series.

(7) Release the exposure button actuator. All of the meters will reset automatically.

(8) Repeat steps 5 through 7 twice (a total of three times). The exposure readings obtained must be within specifications.

(9) Move the light level selector to 6.25. Repeat steps 5 through 7. The readings must agree with specifications.

(10) Move the light level selector to 800. Repeat steps 5 through 7. All readings must agree with specifications.

(11) Recycle the camera by removing it from the horn and then reinstalling it on the horn. This is necessary for the next portion of the testing.

c. Flash Circuit and S9 Mode Test

(1) Set 5.0 volts on the tester voltmeter. Set light level at 6.25 and close S2.

(2) Press the exposure button. The number one READY lamp will go off and the number one FLASH indicator lamp will light.

(3) Press and release the exposure button four more times. The READY lamps should go

off and the FLASH indicator lamps should light in numerical sequence each time the exposure button is pressed.

(4) Press and release the RESET button on the flash simulator assembly.

(5) Press and release the exposure button five more times. The READY and FLASH indicator lamps should sequence as in step 3.

(6) On the flash simulator assembly, press and release the RESET button.

(7) Press the exposure button actuator. The number one READY indicator lamp should remain lighted and the number one FLASH indicator should not light. (Checks S9.)

NOTE: The toggle switches on the flash simulator assembly can be used to simulate normal or used flash lamps. By setting the individual switches, partially exhausted or defective flash bars can be simulated.

d. Follow-Focus Test

The follow-focus test is used to determine how well the shutter blade opening follows the focusing of the lens in flash mode operation. The APERTURE meter is used in this test. It is calibrated in stops and when the test is performed, it will indicate stops deviation from the ideal design aperture. To perform the follow-focus test, proceed as follows:

(1) Set the camera focus to infinity and the L/D control to mid-range. Set the power supply to 5.8 volts.

(2) Remove the front cover from the camera and install the S7 switch actuator.

(3) Install the camera on the horn of the tester. The camera should go through its darkslide cycle.

(4) Remove the camera from the tester and set it on the collimator.

(5) Swing the 8' and infinity lenses into their vertical positions on the collimator and look through the camera eyelens.

(6) Turn the focus wheel until the vertical line in the center target is straight (refer to Figure 3-4). The camera is now collimated for the 8' setting. Tape the focus wheel so it can't be accidently moved.

(7) Remove the camera from the collimator and place it on the tester.

(8) Install the flash simulator plug into the socket on the camera and close the S2 CLOSE-OPEN SWITCH.

(9) Set the light level selector to 800 cdls/ft^2.

(10) Set the flash mode aperture switch to 8'.

(11) Block any light from the photocell on the camera using a square of cardboard or other material.

(12) Depress the exposure button and observe the APERTURE meter.

(13) Record the 8' APERTURE reading and compare it to the STANDARDS Chart.

(14) Remove the tape from the focus wheel and rotate the wheel to the 10.4" setting.

(15) Set the flash mode aperture switch to 10.4".

(16) With the photocell still blocked, press the exposure button and observe the APERTURE meter.

(17) Record the 10.4" APERTURE reading and compare it to the STANDARDS Chart.

(18) If the reading is high at the 8 foot setting, and the needle goes off scale at the 10.4" setting, the interceptor mechanism is defective. (See Section 4 for repair/adjustment.)

(19) If on-scale readings are obtained for 8' but the 10.4" reading is either high or low, the interceptor can be adjusted. The problem can be either the interceptor link or the interceptor cam. (See Section 4 for repair/adjustment.)

(20) When repairs/adjustments are complete, recheck the follow-focus function. If problems still exist, see paragraph G, Section 4, Repairs/Adjustments, "Interceptor on Wrong Side of Stop Pin".

MODEL B CAMERA TESTER

a. Set-Up

(1) Be certain that the comparalumen light source and electronics module are on a flat work surface and plugged into separate 110 VAC outlets.

(2) Plug the cable assembly from the horn into the socket located on the front of the electronics module.

NOTE: There is no warm up time required for the Model B Tester components.

b. Comparalumen Light Specifications

The following table shows the luminance levels of various settings used for camera testing.

c. Ambient Exposure Measurements

(1) Remove the front cover from the camera.

(2) Close the S7 switch using the S7 actuator.

(3) Set the L/D control to the mid-range position using the trim reset cam and focus the camera at infinity.

(4) Slide the camera fully onto the horn.

(5) Select the light level desired on the Comparalumen and slide the horn up against the appropriate window. (Position the horn so that the locating pad on the front of the horn touches the window.)

(6) Insert a remote shutter release cable into the socket on the right side of the shutter.

(7) Rotate the RANGE switch on the electronics module to the SX-70 EXP position.

(8) Lift the EXPOSURE-APERTURE MODE switch to the EXPOSURE position.

(9) Press the remote shutter trip button and read the exposure on the meter.

(10) Return the EXPOSURE-APERTURE MODE switch to the RESET position.

d. 10.4" Aperture Measurement

NOTE: This measurement must be preceded by steps 1 through 5 of the Ambient Exposure Measurement procedure, then complete the following:

(1) Rotate the camera focus wheel to the 10.4" setting.

(2) Insert a used flash bar into the camera flash socket and position the spring clip (supplied with the tester) over the flash bar so the photocell is covered.

(3) Select the 800 cdls/ft^2 on the Comparalumen and position the camera at the right-hand screen.

(4) Rotate the RANGE switch to the 10.4" position.

(5) Place the EXPOSURE-APERTURE MODE switch in the APERTURE position.

(6) Press the remote shutter trip button and read the aperture in relative stops, on the meter.

(7) Return the EXPOSURE-APERTURE MODE switch to the center (RESET) position.

NOTE: If a meter reading goes off scale (greater than +1 stop), press the +1 stop pushbutton on the electronics module and read the meter, adding +1 stops to whatever the meter is indicating.

4. Light Leak Tester (Figure 3-8)

Caution: When using the light leak tester, always hold the fixture so the camera is in the uppermost

COMPARALUMEN LIGHT LEVELS TABLE

800 cdls/ft^2	–	Move the center switch on the Comparalumen to the right to illuminate the right (high level) screen. No filters are used for the 800 cdls/ft^2 level.
100 cdls/ft^2	–	Proceed as for the 800 level, but insert both filters (one stop down and two stops down) into the slot above the right (high level) screen.
50 cdls/ft^2	–	Move the center switch to the left to illuminate the left (low level) screen. No filters are used for the 50 cdls/ft^2 level.
6.25 cdls/ft^2	–	Proceed as for the 50 cdls/ft^2 level, but insert both filters (one stop down and two stops down) into the slot above the left screen.

NOTE: On some Comparalumens it has been found necessary to reverse the filters when used to reduce the 50 cdls/ft^2 to 6.25 cdls/ft^2. In this case the filters are labeled so that the proper label (100 or 6.25) must be facing the operator when the filters are used.

Caution: To avoid possible delamination of the filters, do not leave the Comparalumen on at 100 cdls/ft^2 any longer than necessary. It should not be on any longer than the minute or two needed to check the camera.

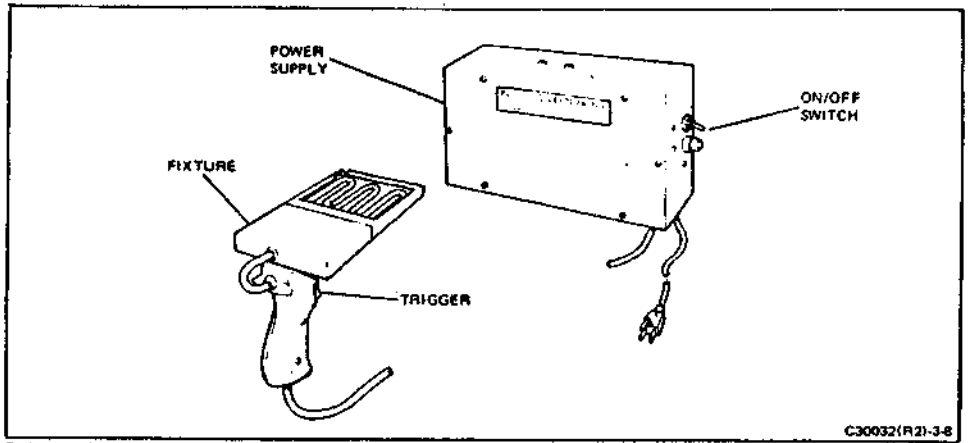


FIGURE 3-8 LIGHT-LEAK TEST SYSTEM

position with the lens pointing down. There is no latching device on the fixture and the camera could slide off if the fixture were pointed down.

The light leak tester consists of two checks: the static test (with the camera in the mirror-down or viewing position) and the dynamic test (with the camera in the mirror-up picture taking position). (Both of these tests must be done in a darkened area.)

a. Static Tests

(1) Erect the camera and remove the front cover assembly. Close S7.

(2) Turn on the power supply and insert the light-leak fixture into the camera film compartment. The camera should run through the dark-slide-eject cycle.

(3) Darken room.

(4) Press and hold the fixture trigger.

(5) Examine the camera from all angles, looking for light-leaks. Note the location of any light-leaks and continue below with the dynamic test. (Leaks are most likely at the hinge area between the inner frame and mirror cover and at the boot tab area.)

b. Dynamic Tests

(1) Cover the photocell lens and trip the shutter. With the photocell lens covered, the mirror should stay in the raised (picture taking) position long enough to perform the dynamic light-leak test, approximately 13–28 seconds.

(2) Press and hold the fixture trigger.

(3) Examine the camera for light-leaks. Gently flex the boot while looking for leaks. Note the location of any light leaks. (You may see a small amount of light in the area where the boot joins the shutter housing. This is light emanating from the substrate and is normal.) Allow camera cycle completion and remove the fixture.

(4) Turn off the power.

(5) Repair any light-leaks noted in the previous testing. If light-leak repairs are made, retest the camera.

5. Flash Simulator Board (Figure 3-9)

The Flash Simulator Board provides a quick, easy method for checking the flash firing capability of the SX-70 camera. Figure 3-9 shows the board

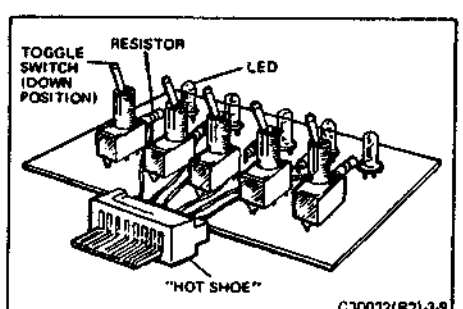


FIGURE 3-9 FLASH SIMULATOR BOARD

which contains five light emitting diodes (LED), five resistors, and five toggle switches. Providing the interface with the camera socket is a "hot shoe" assembly which reduces wear on the board contacts. Use the simulator as follows:

a. Insure that all switches are in the position shown (down).

b. Insert a film pack or film pack simulator into the camera. Operating voltage is 5.0V to 6.4V.

c. Install the flash simulator board into the camera flashbar socket in the same way as a flashbar would be installed.

d. Press the red exposure button, S1.

e. Observe that LED #1 flashes.

f. Flip switch S1 up.

g. Press the red exposure button.

h. Observe that LED #2 flashes.

i. Flip switch S2 up.

j. In like manner, continue pressing the red exposure button and flipping the corresponding switches up until all five lights have flashed.

k. Repeat steps d through j. The lights should flash five more times.

l. Press S1.

m. Observe that no light flashes. This confirms proper operation of S9.

6. Manual Function Tester (Figure 3-10)

NOTE: The Manual Function Tester #11959 is an updated version of the Camera Back Simulator #11775. The basic difference between the two pieces of test equipment is that the simulator relies on an external power supply while the function tester has a built-in power supply. The steps listed in paragraph b, Test, apply to both units. Remember, if the shutter tests satisfactorily at 5 volts, the test must be repeated at 6.4 volts.

Set-Up

(1) Using a VOM, check for shorts on the shutter before setting it on the tester. (Not necessary for plastic base shutter.) Check between + and – points on the substrate and

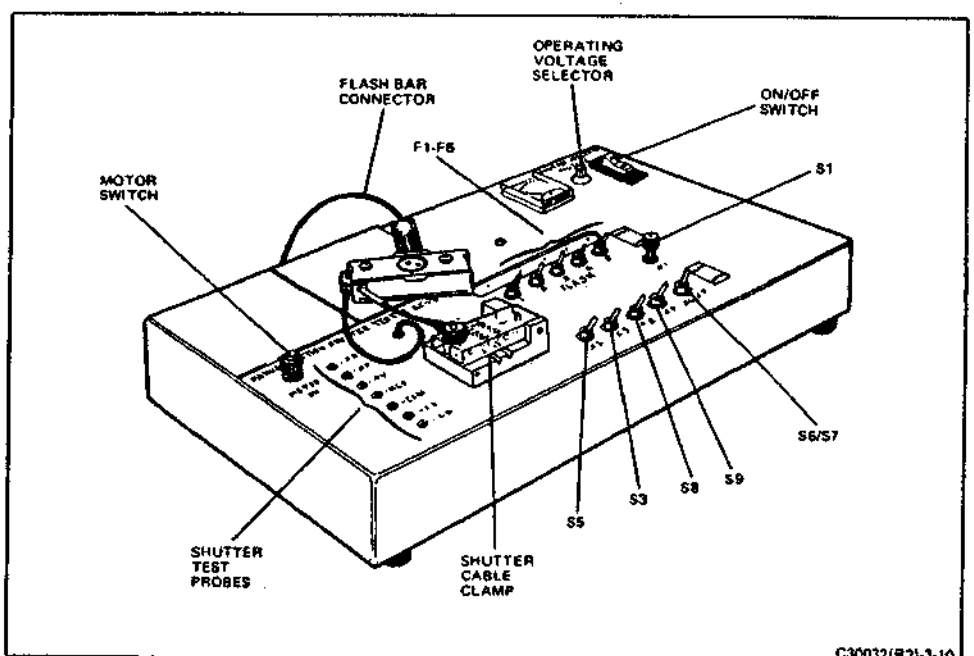


FIGURE 3-10 MANUAL CAMERA TESTER

the casting. There must be no shorts.

(2) Set power supply to 5.0 volts. (If simulator is being used, connect to power supply, set supply to 5.0 volts and switch supply from VOLTS to AMPS.)

(3) CLOSE tester switches: S2, S3, S5, F1 thru F5.

(4) OPEN tester switches: S1, S6/S7, S8, S9.

(5) Clamp shutter cable in connector and insert flash bar connector into shutter FFA.

(6) Set shutter lens to 10.4" and trim wheel to full dark.

(7) Proceed with testing as indicated in table below. If shutter tests ok at 5.0 volts, retest at 6.4 volts.

MANUAL FUNCTION TEST SEQUENCE

Test Mode	Action	Shutter Response
S6/S7	Close S6/S7 Press and release S1 button to check for mechanical binding. Observe current drain.	No reaction (Blades open, motor off)
AMBIENT Exposure Mode	Remove flash array from shutter. Close S1 Open S5 Open S1 Open S3 Close S3 Close S5	 Blades close; motor runs Blades close; motor brakes Blades close; motor brakes (no reaction) Blades open then close; motor runs (exposure time dependent on amount of light seen by photocell) Blades close; motor runs Blades open; motor brakes
S8 Dark Slide eject mode (Flash Array Inserted)	Close S8 Close S6/S7 Open S5 Open S3 Close S3 Open S8 Close S5	Blades open; motor brakes (no reaction) Blades close; motor runs Blades close; motor runs Blades close; motor runs; no flash Blades close; motor runs Blades close; motor runs Blades open; motor brakes
Flash Mode – flash array inserted into shutter	Close S1 Open S5 Open S1 Open S3 Close S3 Close S5 Open F1 thru F5 consecutively, repeating above test between each switch opening.	Blades close; motor runs Blades close; motor brakes Blades close; motor brakes (no reaction) Blades open then close (small aperture) flash fires; motor runs Blades close; motor runs Blades open; motor brakes Bulbs fire in sequence
S9 – Empty film pack mode	Close switches F1 thru F5 Close S9 Close S1 Open S5 Open S1 Open S3 Close S3 Close S5	 Blades open; motor brakes (no reaction) Blades close; motor runs Blades close; motor brakes Blades close; motor brakes (no reaction) Blades open then close (fixed time) no flash; motor runs Blades close; motor runs Blades open; motor brakes

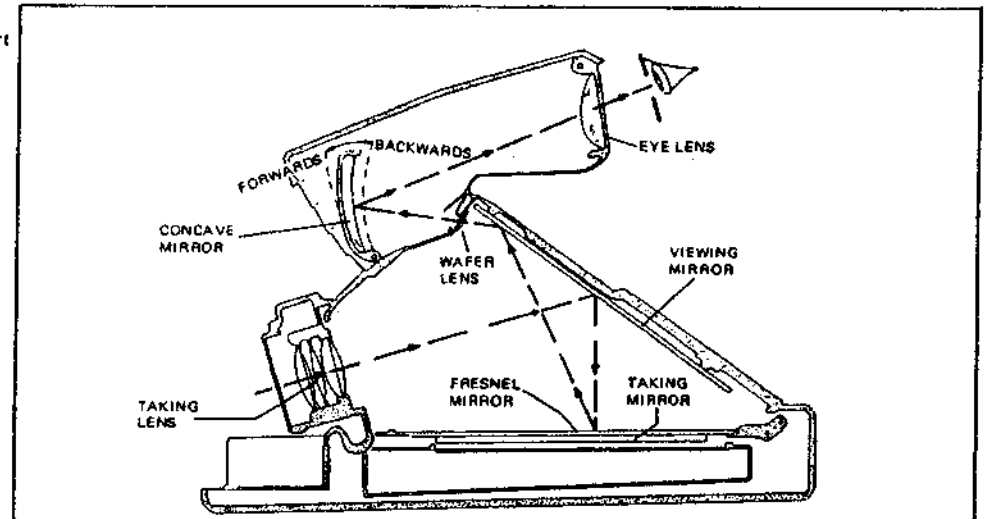


FIGURE 3-11 SX-70 VIEWFINDER SYSTEM

D. OPTICAL SYSTEM

Viewfinder quality refers to the general quality and alignment of the camera optics. For the user, it can be precisely defined as the appearance and clarity of the image as seen through the viewing system (Figure 3-11). When a camera has poor viewfinder quality, it is difficult to obtain a sharp image. Certain parts of the field always seem out of focus and the image lacks crispness, having a hazy appearance usually in the vertical plane. Since flash pictures are critically dependent on accurate focusing, a poor viewfinder system will make the taking of good flash pictures difficult.

Failure Analysis Chart #5 will enable you to trace most problems in the viewing system to their source. Corrective actions are shown and where they are complicated are presented in Section 4. Presented here are several checks which require greater detail than the charts provide.

1. Exit Pupil Test

a. Mount the exit pupil gage onto the camera eyelens (Figure 3-12).

(1) Engage the left side gage rail on the eyelens. (The right side is identified by a 3/4" horizontal slot.)

(2) Slowly slide the right side in place. A distinct "clicking" will be heard when the gage is secure.

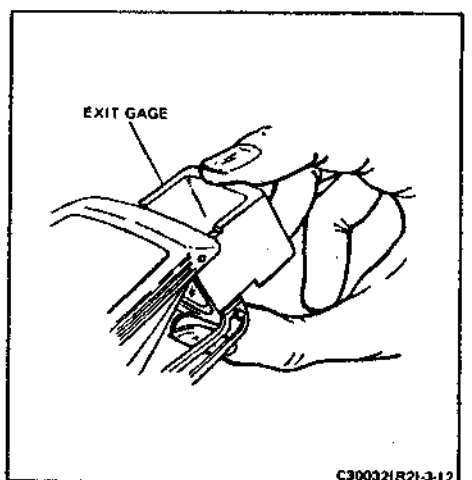


FIGURE 3-12 INSTALLING THE EXIT PUPIL GAGE

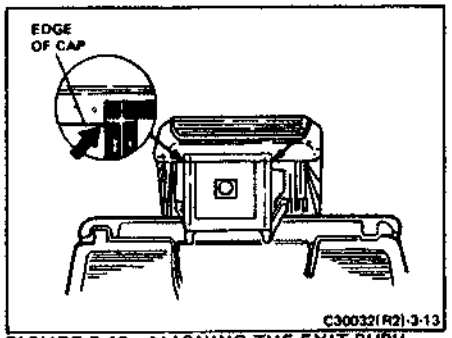


FIGURE 3-13 ALIGNING THE EXIT PUPIL GAGE

(3) The mounting rails for the gage must be flush with the eyelens frame. Check by holding the bottom of the eyelens frame with the thumb and apply slight pressure on the upper front of the gage with the right index finger. The gage should be secure.

NOTE: A left handed person may find it easier to reverse the mounting and securing process.

b. Point the camera lens at a light source while holding the viewfinder eyelens (with gage) about 18 inches away from your eye.

c. Align the bottom of the viewfinder cap with the horizontal white line on the front of the gage. Center the eyelens supports with the vertical white lines (Figure 3-13).

d. Close one eye and view the exit pupil image in the gage.

e. To be within acceptable limits, the pupil (a bright circular image) must appear in the center of the square opening in the face of the gage. If the pupil is not in the center, adjust the optics system according to instructions in Section 4, "Viewfinder System".

2. Entrance Pupil Test

a. Set the focus wheel to 10.4".

b. Hold the camera at arm's length, with the taking lens toward you and a bright light source behind the camera.

c. Look through the taking lens, closing one eye. Observe the entrance pupil in the lens.

d. Raise the front of the camera about 10° and note two bright circles against a dark background. Both circles should be vertically positioned ±.050" from the center as shown in Figure 3-14B.

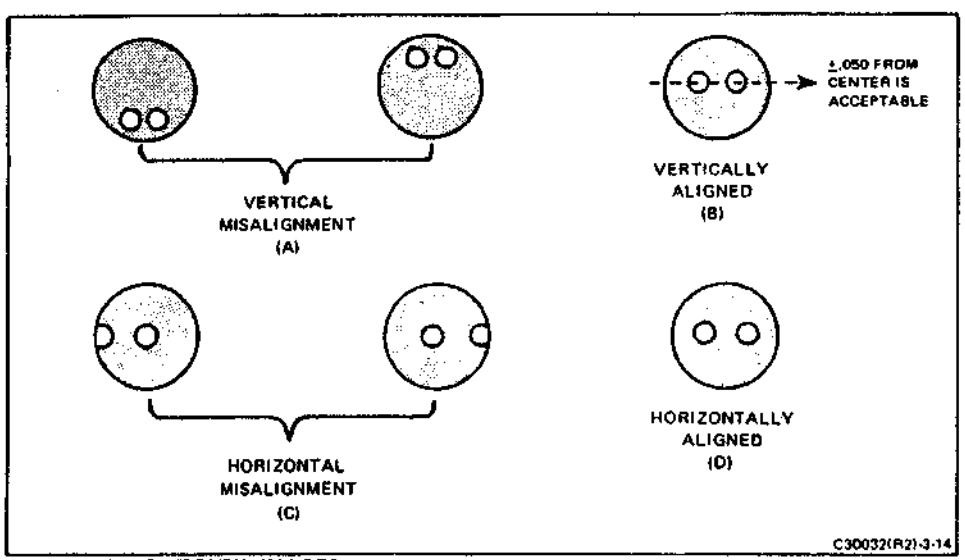


FIGURE 3-14 EXIT PUPIL IMAGES

e. If the circles are not centered vertically (Figure 3-14A), perform the erecting link adjustment in Section 4.

f. If the circles are displaced horizontally (Figure 3-14D), make the side-to-side adjustment of the fresnel carrier which is included in Section 4.

3. Concave Mirror Distortion Check

a. Focus on a target which presents a clear vertical line (for example, a door frame).

b. Scan the camera horizontally.

c. If the mirror is not distorted, the vertical line seen in the eyepicee will vary as the camera is scanned. At either side of the field, the line will be bent while in the center of the field, the line will be straight (see Figure 3-15A).

d. If the mirror is distorted, the vertical lines change more graphically as the image is scanned and one or several reversals of direction of bending may occur (Figure 3-15B).

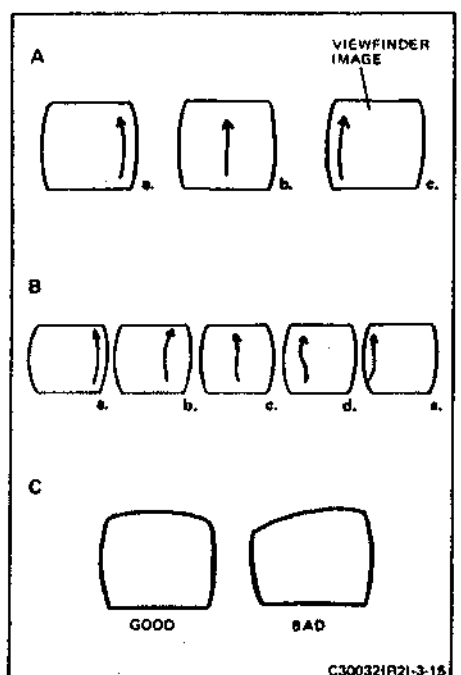


FIGURE 3-15 IDENTIFYING DISTORTED MIRRORS

e. A telephone directory page at a distance of 2 feet may be used to check distortion. The white pages have high contrast, fine detail and uniform printing.

f. The frame around the viewfinder may appear non-symmetrical about the vertical axis. A normal mirror will appear to be symmetrical about the axis (Figure 3-15C).

4. Fresnel Quality Check

The fresnel screen must be examined for blemishes, shadows, dirt, scratches, etc. A standards chart (Figure 3-16) is available for determining whether the fresnel being examined is acceptable. Focus the camera to 10.4" for viewing the chart.

a. First, view the fresnel against the background presented in Section 1 of the chart. Note whether the defects (dirt, scratches, digs, etc.) are in the A or B area of the fresnel.

b. Next, compare any boot or mirror marks on the fresnel with the marks shown in Section 2 of the chart. If the mark exceeds that shown on the chart, the fresnel is not acceptable.

c. View the fresnel screen against the background of Section 3 on the chart. The conditions shown on the chart are the maximum acceptable limits for fresnel defects. If the fresnel being examined has defects which go beyond those shown on the chart, reject the fresnel. (Note that an illustrated listing on the chart is available for comparison to fresnel which have only one or two blemishes.

d. Examine any shading on the fresnel against the limits shown in Section 4 of the chart. If the shading extends beyond the area (top or bottom of the fresnel) shown on the chart, the fresnel is not acceptable.

e. Examine the split image circle by comparing it against the examples shown on the chart. If the shading on the split is greater than shown or if there is more than one dig, pit, stain, or scratch on the split, the fresnel is not acceptable. The fresnel must also be rejected if the blemish on the split is larger than any shown on the chart.

5. Collimation

For the collimation procedure, refer to paragraph D, "Test Equipment Operation".

E. USE OF ANALYSIS CHARTS

The following charts should be used to identify

and correct faulty camera operation. It will seldom be necessary to consult every chart. Only those related to a particular malfunction should be consulted. In some cases, the customer's complaint will be sufficiently specific to lead you to a particular chart. In other cases, the preliminary inspection procedure at the beginning of this section will provide useful information to lead you to a chart. In all cases, the fault-analysis charts present the logical sequence of checks and remedial procedures. These charts are divided into three parts: one, (CAMERA ANALYSIS) for problem analysis when the camera is completely assembled; two, (OPTICAL ANALYSIS) for analysis of viewfinder parts; and three, (SHUTTER ANALYSIS) for detailed shutter analysis. The

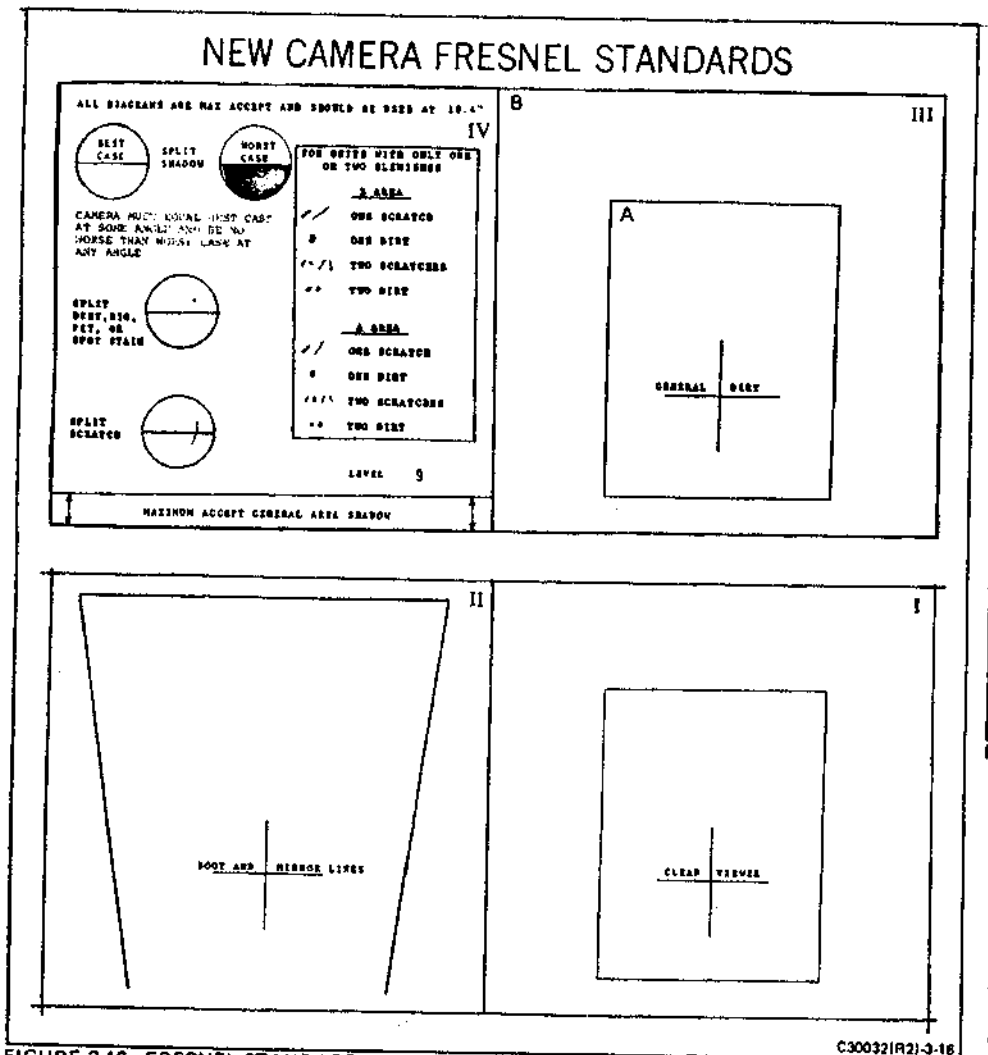


FIGURE 3-16 FRESNEL STANDARDS CHART

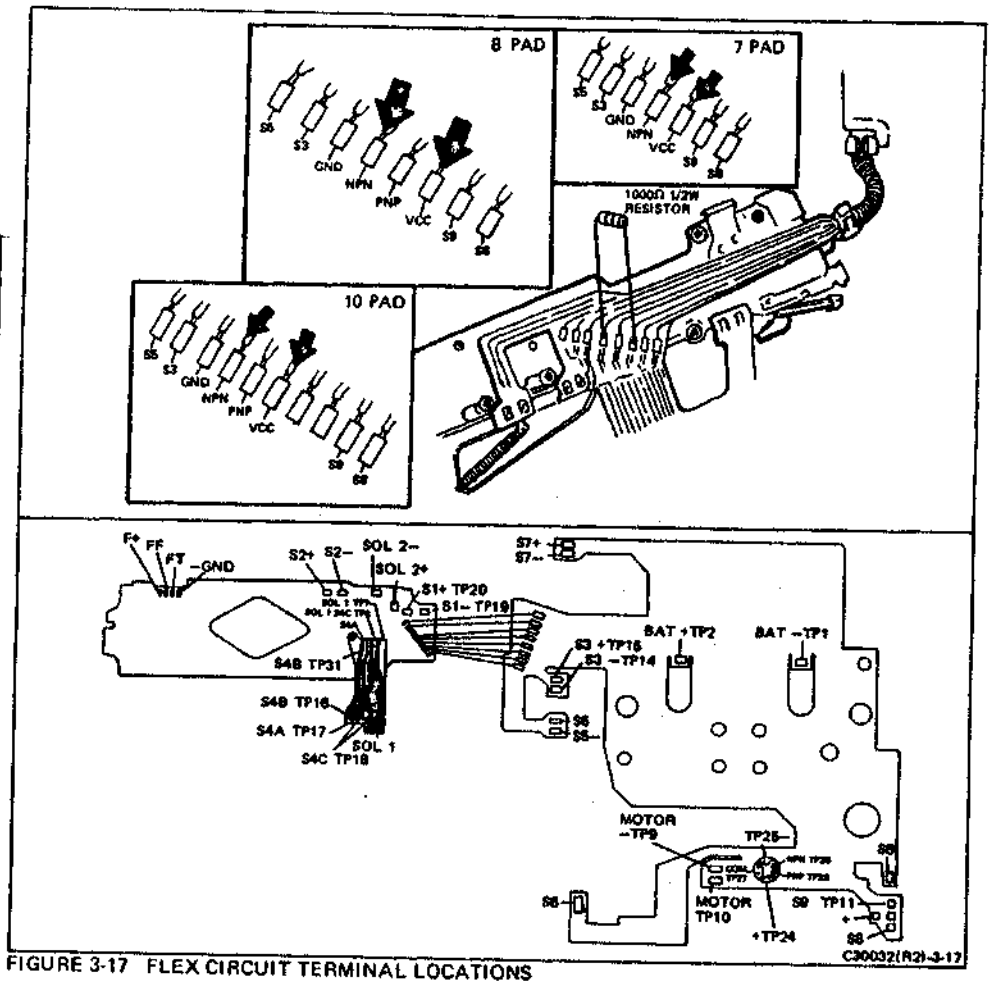


FIGURE 3-17 FLEX CIRCUIT TERMINAL LOCATIONS

SHUTTER ANALYSIS charts should be used only after the shutter has been unsoldered from the camera. If repairs and/or replacements are indicated, the procedures are described in Section IV.

1. Camera/Shutter Isolation

To expedite the repair procedure, it is essential that the malfunction be isolated to either the camera back or the shutter as early as possible in the troubleshooting procedure. The sequence should not be considered inflexible, however.

a. Disassemble the camera to the point where the terminals on the flex circuit are accessible (Figure 3-17).

b. Tack solder a 1000 ohm, 1/2 watt resistor across the VCC and NPN terminals as shown. (This procedure does not apply to mid-cycle shutdown. Refer to the Failure Analysis Charts.)

NOTE: On 10-pad flex circuits, these are the TP6 and TP30 terminals. On 8-pad circuits, these are the TP4 and TP21 terminals. On 7-pad flex circuits, where the PNP pad is eliminated, the

NPN terminal is located directly adjacent to the VCC terminal. Refer to the insets in Figure 3-17 to locate the proper terminals.

c. Close S6 and S7 and apply power:

(1) If the camera cycles, the motor and MCC are OK and the shutter is defective.

(2) If the camera fails to cycle, check the motor and MCC by continuing below.

d. With the 1000 ohm resistor still in place, connect a jumper wire between the motor (minus TP9 contact) and battery (minus TP1 contact) for a moment:

(1) If the motor runs, the MCC is defective.

(2) If the motor does not run, the motor is defective.

e. Remove the jumper immediately after determining the fault area.

2. Camera Analysis Charts

Once familiarity with the system is gained, repair people can rely on the failure analysis charts to troubleshoot camera problems. When the charts lead you to a repair procedure, refer to Section 4, Repairs and Adjustments for the necessary information. Set up the test equipment as shown in Figure 3-18. The film pack simulator is inserted into the camera and the negative lead from the VOM is connected to camera ground through the power supply. This allows all the tests to be completed simply by moving the VOM lead as a probe from point to point. Figure 3-17 in conjunction with Figure 3-19 will assist you in locating the test points or terminals called out.

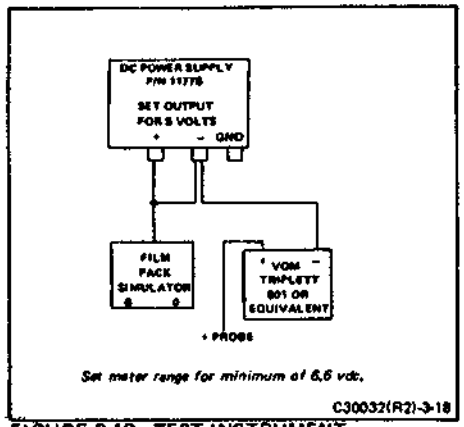


FIGURE 3-18 TEST INSTRUMENT CONNECTIONS

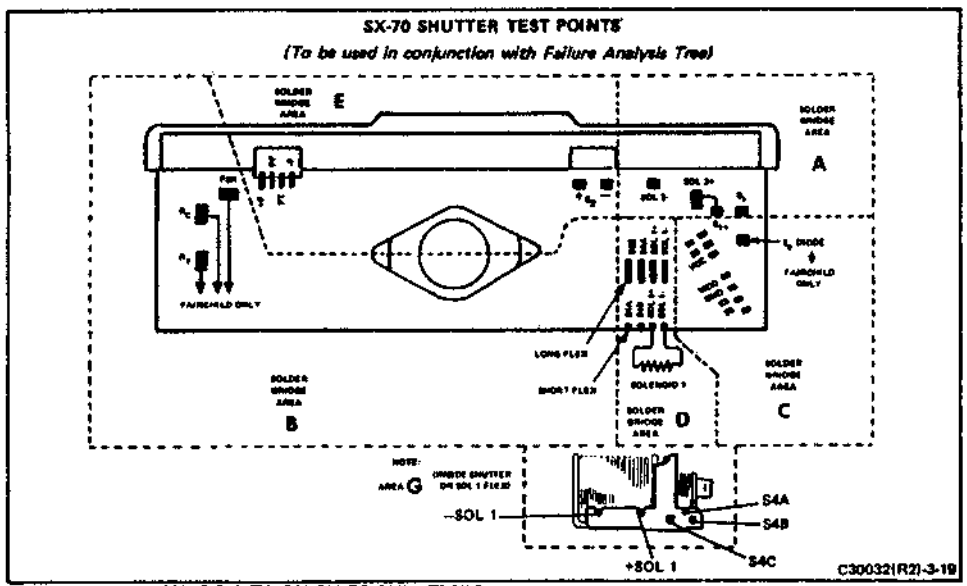


FIGURE 3-19 TEST POINTS ON SX-70 SHUTTERS

IV - REPAIR AND ADJUSTMENTS

INTRODUCTION

This section of the manual is primarily devoted to disassembly/reassembly procedures. These procedures provide step-by-step instructions aimed at guiding the technician through the intricacies of SX-70 camera repair. The procedures cover such things as replacement of defective mechanical parts, realignment of improper linkages or connections, repair of electrical malfunctions, and adjustments needed to return the camera to proper operation.

It should be stressed that these procedures are intended to serve as guides for the experienced repair technician. Except where noted otherwise, the actual repair procedure to be used is left to the discretion of trained personnel. Their combination of training and experience should be sufficient to allow repair personnel to make on-the-spot judgements as to the best method of repair. A major factor which must be considered is the trade-off between time and cost of materials. If the repair is easy and feasible from a cost viewpoint, it should be made. Otherwise, replacement of a part or sub-assembly is the proper choice.

There is one other general note that pertains to SX-70 camera repair. Occasionally, screw holes in the plastic become stripped. This is most apt to occur in the counter mounts, the motor mounts and where the rear upper inner frame meets the outerplate. To make an effective repair when this happens, replace the original screw with an oversize screw or insert a thin sliver of plastic into the stripped hole before the original screw is returned.

A. FRONT COVER/SPREAD ROLL ASSEMBLY

The spread rolls in the SX-70 camera are gear driven by the main gear train. Thus, in addition to wear or damage to the rolls, it is possible to encounter wear and/or damage to the drive gears. Regardless of the nature of the malfunction, the complete assembly must be replaced. The following paragraphs describe the replacement procedure.

Removal

1. Erect the camera to picture-taking configuration.
2. Open the front cover by depressing the front cover release latch on the right side of the camera bed.
3. Apply pressure to the side of the cover adjacent to the cover hinge area. Press toward the gear train side of the camera. This will release the front cover. On newer models, detach the front cover from the right side (gear train side) only.
4. Inspect and clean the rollers and gears with a Q-tip moistened in water. If film developer is observed under the light shield or in the film catcher spring area, the front cover housing must be replaced.
5. If necessary, as described above, replace the front cover housing and test.
6. If the spread-roll assembly is to be removed, strip the leather from the cover. (Start pulling the leather from the back and pull toward the film exit. Do not start at the film exit.) Take out two screws which secure the spread rollers to the inside of the front cover, and remove the roll assembly from the front cover.

Installation

1. Position the spread-roll assembly in the front cover so that the gears will mate with the main gear train when the cover is in place.
2. Install and tighten the two retaining screws used to secure the rolls.

   NOTE: A new self-tapping, square socket head, coarse thread screw, P/N 705564 is used to effect a repair of a stripped thread in the front cover assembly when installing a spread system assembly. If the hole was stripped during disassembly, the new screw will permit easy reassembly. (This screw is standard on newer cameras.)

   A new square screwdriver tool bit, P/N 11867, is available from Waltham Parts Dept.
3. Position the front cover housing on the camera.
4. Install the decorative leather covering. Make sure the film exit is not covered by the leather.
5. Install the front cover by squeezing the sides of the cover just enough to engage the hinge on the pivot points of the bottom plate.
6. Close the cover and check the camera for proper operation.

   NOTE: If mishandling or dropping of the camera causes breakage of the extruded metal studs used to secure and pivot the front cover,

no repair is possible. You must replace the inner camera back assembly. Figure 4-1 illustrates the studs mentioned.

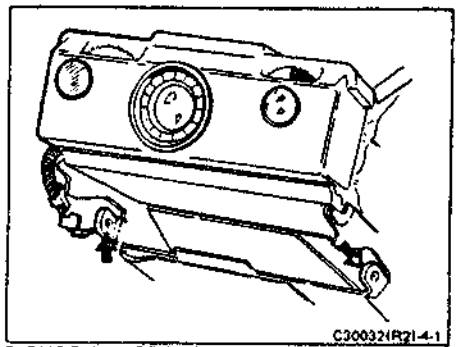


FIGURE 4-1 FRONT COVER HINGE STUDS

Repairs/Adjustments

1. Loose Front Covers

Some cameras have been detected with loose front covers due to improper latching. This problem occurs when the "knife edge" of the front cover latch is not firmly, and/or correctly seated in the latch retainer, thereby causing excess "play" between the latch and retainer. To resolve this problem, perform the following procedures:

a. Confirm that the problem is not caused by loose screws on the spread system assembly by closing the front cover, and, while rocking it slightly, observing for excessive play.

b. Two vendors produce the spread system assembly bracket (see Figure 4-2). One vendor, Ramcel, makes the bracket with a retainer area which is not bent. The other vendor makes the bracket with a bent retainer area. Most of the loose front cover problems occur with the bent retainer area. Therefore, a simple solution is to replace the front cover or a spread system subassembly with one containing a Ramcel spread roller bracket. However, before doing this, try the repair procedure called out in paragraph c, below. (Do not scrap the original front cover since it is still usable on other cameras.)

c. If a Ramcel bracket front cover is not available, use the following procedure to correct the loose front cover.

(1) Open the front cover.

(2) Remove the gear train cover.

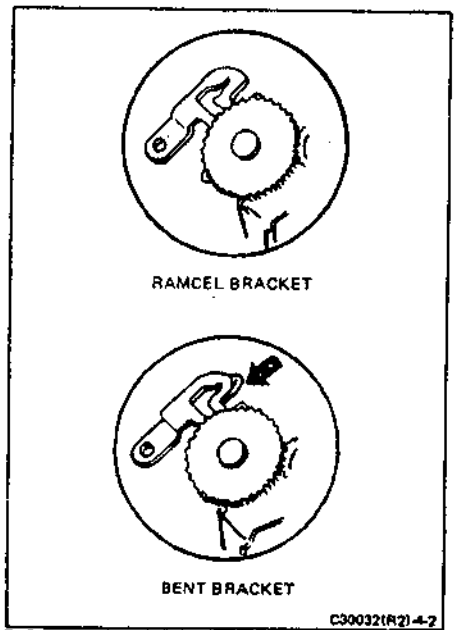


FIGURE 4-2 COMPARISON OF SPREAD ROLL BRACKETS

(3) With the latch depressed, use needle-nose pliers to bend the knife edge of the latch inboard (away from the front cover) slightly less than 90°, as shown in Figure 4-3.

(4) Close the front cover and recheck; bend further if necessary.

(5) With the front cover open, observe for a clearance between the latch and the 3rd idler gear.

(6) Observe that the stop pin (see Figure 4-3) is not resting on the outer plate when the front cover is closed. When resting on the outer plate, the latch/front cover closing system will loosen from wear in a short time. Make the following observation:

- Open the front cover and note the location of the front cover latch decal (arrow).
- Close the front cover & note the decal location. The decal arrow should be closer to the bottom cover (Figure 4-4). If not, it is an indication of front cover looseness which should be corrected.

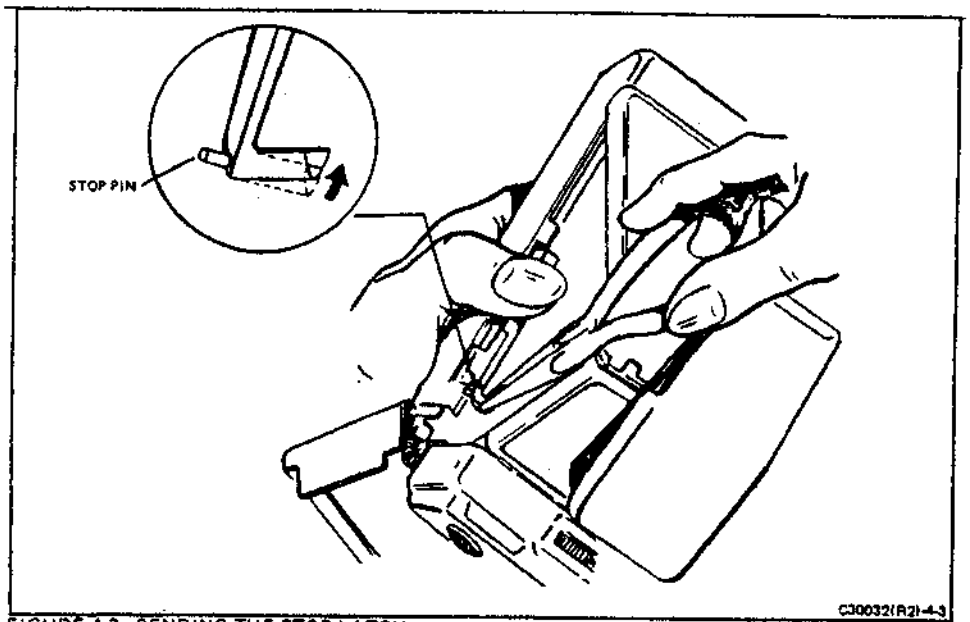


FIGURE 4-3 BENDING THE STOP LATCH

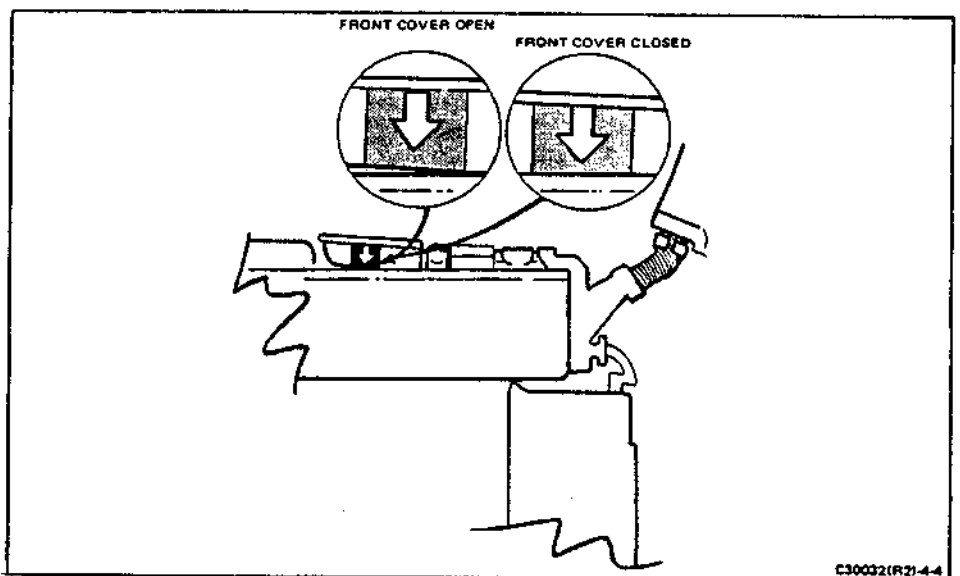


FIGURE 4-4 COMPARISON OF DECAL BEFORE AND AFTER FRONT COVER CLOSURE

2. Interference Between Front and Bottom Covers

A few cameras may have an interference fit between the S7 actuator post and the edge of the bottom cover when the front cover is opened. The problem has been traced to slightly oversize bottom covers. Problem bottom covers have a mold mark "PP 2½".

One method of correction is to bias the bottom cover and front cover away from each other to the limit of the screw holes. In an extreme case, you may be able to grind the required clearance from the S7 actuator post on the front cover.

Correction of this interference problem should only be at customer request since the problem diminishes with use.

3. Top Spread Roll Looseness

There have been instances of the top spread roll popping out of the spread system. To eliminate the problem, the new spread rolls have a cap welded on the end opposite the drive gear (Figure 4-5). The cap captures the spread roll in the spread system frame.

When making any repairs requiring replacement of either the spread system or the front cover assembly, replace the old spread system with a new one. If you install a new spread system in an old front cover, you must remove the light seal before installing the new spread system. The new light seal is adhered directly to the spreader before the spreader is installed in the front cover.

4. Replacing the Light Shield Cam

A manufacturing change to the Trim Assembly was made to overcome erratic action. Part of this change was to revise the cam on the light shield. (This cam resets the Trim Assembly each time the camera is closed.) Figure 4-6 compares the old shutter and cam with the new shutter and cam. The cam on the light shield of the front cover has been made wider and deeper. The tang of the trim reset lever (shutter) is now a flat bar about 1/16 of an inch wide and appears off center. It is a brass or flat black color. (All replacement shutters will be the new type.) The improved shutter will also have a cut out area larger and squarer in shape than the older version.

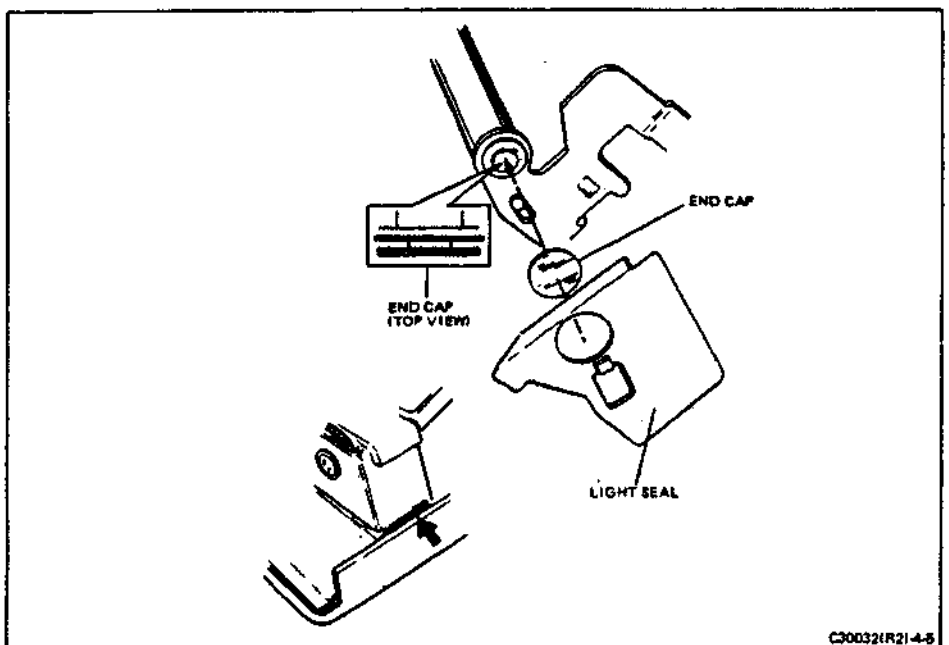


FIGURE 4-5 NEW SPREAD ROLL CONFIGURATION

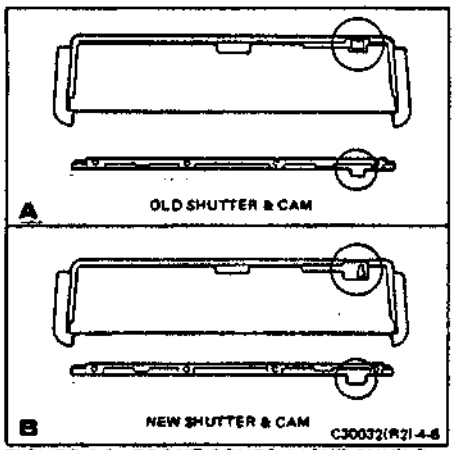


FIGURE 4-6 FRONT COVER LIGHT SHIELD CAM

When a new type shutter is installed, the cam in the light shield must be inspected and changed if necessary. The new cam should be installed in the same place and manner as the old cam. See Figure 4-7. Remove the old cam using an x-acto knife to cut the plastic rivets. Place the new cam in the same position, making sure the cam lip goes over the edge of the light-shield as shown, and the pins go through the four holes. When assembled, apply heat enough to peen over the ends of the pins projecting through the holes – thus staking the unit in place.

If new cams are not available, it will be necessary to install a new front cover assembly.

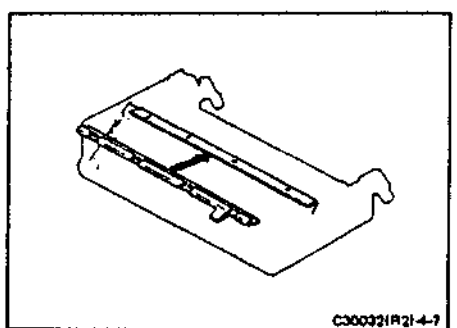


FIGURE 4-7 REPLACING LIGHT SHIELD CAM

B. MIRROR COVER/BOOT ASSEMBLY

The mirror cover assembly consists of the mirror cover, the boot, and the viewing mirror. Because of its construction, it is not feasible to disassemble the mirror cover assembly itself and, therefore, whenever one of its major components fails the entire assembly is replaced. The mirror cover could sustain damage in the form of cracks or broken hinges, or overall distortion. The boot could be cut, torn or damaged by wear. The mirror could be loose or displaced in its mount, broken, or its surface damaged beyond cleaning. Should any of these faults be evidenced, replace the assembly.

NOTE: On older cameras, a coding system is used to match fresnels and mirror covers. When changing mirror cover and fresnel assemblies, correct color coding must be employed to prevent unacceptable tolerance buildup. This is usually demonstrated by difficult closing of the camera, etc. The chart below shows the color codes to be used: i.e., a red coded fresnel goes with either a red, yellow, blue or white mirror cover; not with a green mirror cover. The choice should be the first in order in the chart. Red first, yellow second, etc. The color code is located on the mirror cover, on the underside, upper right-hand corner, viewed as if holding the camera to take pictures. On the fresnel assembly, it is marked on the protective paper at the point where the adhesive seals the paper around the fresnel.

COLOR CODES USED WHEN CHANGING FRESNELS AND MIRROR COVERS

	MIRROR COVER				
Fresnel	Red	Yellow	Blue	Green	White
Red	x	x	x		x
Yellow	x	x	x	x	x
Blue	x	x	x	x	
Green	x	x	x	x	
Black	x	x			

Newer cameras employ a universal fresnel/mirror cover assembly. No matching of coded parts is necessary.

Removal

1. Erect the camera to picture-taking configuration.
2. Open and remove the front cover.
3. Remove the decorative leather covering from the bottom cover.
4. Remove the four bottom-cover retaining screws.

5. In the following step, the bottom cover will be removed. To prevent damage to the flex circuit, insert a thin strip (a small, metal, six-inch pocket scale, for example) between flex circuit and the inside cover surface. Move the tool from one locating stud to the other as the cover is being removed to prevent sticking to the flex circuit.
6. Lift the cover a small distance away from the camera, then slide the cover from the assembly.
7. Remove the inner-frame-to-boot-retainer screws (see Figure 4-8).

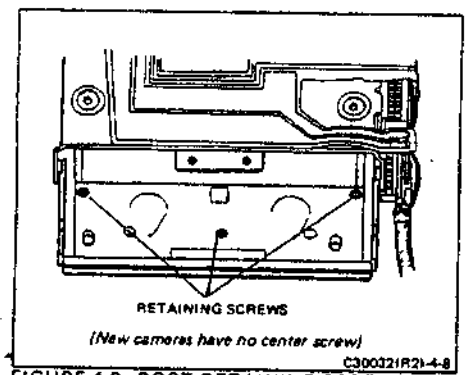


FIGURE 4-8 BOOT RETAINING SCREWS

8. Remove the four shutter housing retaining screws from the rear of the shutter mounting hinge bracket (see Figure 4-9). (Check for square head or Bristol head screw. Replace with same type.)

   Caution: While the shutter is detached from the mounting bracket, make sure no mechanical stress is put on the ribbon cable.

9. Remove the two hinge-bracket-to-boot-retainer screws located adjacent to the round lens opening in the shutter hinge bracket. (Newer cameras have rivets which must be removed.)
10. Using Special Tool #11665, remove the two short-cover-to-mirror-cover hinge pins (Figure 4-10).
11. Using Special Tool #11654, remove the mirror-cover-to-inner-frame hinge pins (Figure 4-11).

    NOTE: Frequently, when removing a mirror cover assembly, the boot retaining tab becomes damaged. A fix for this problem has been devised. Proceed as follows:

    a. Remove the light seal.

    b. Use a No. 62 twist drill in a pin vise and drill a hole 1/8" deep, dead center in the boot retaining tab (Figure 4-12). Hold the boot retainer tightly between thumb and forefinger.

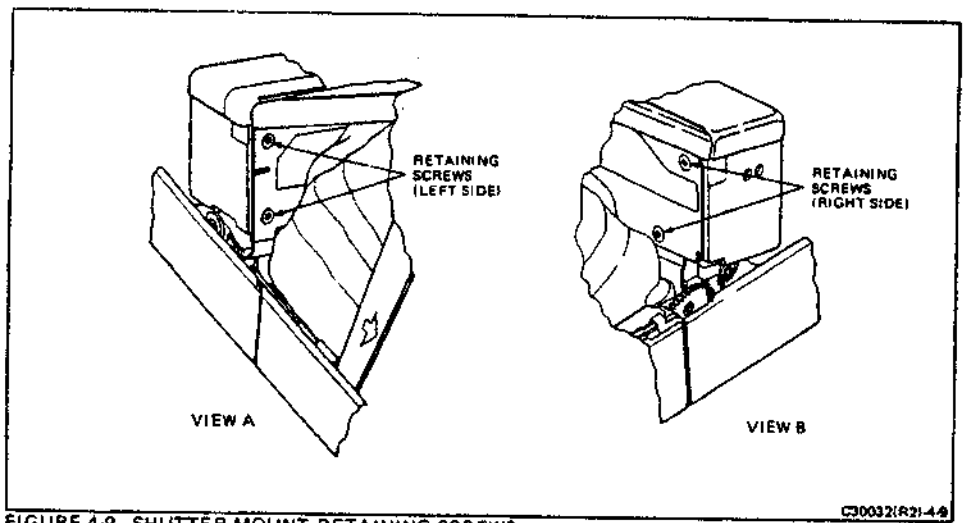


FIGURE 4-9 SHUTTER MOUNT RETAINING SCREWS

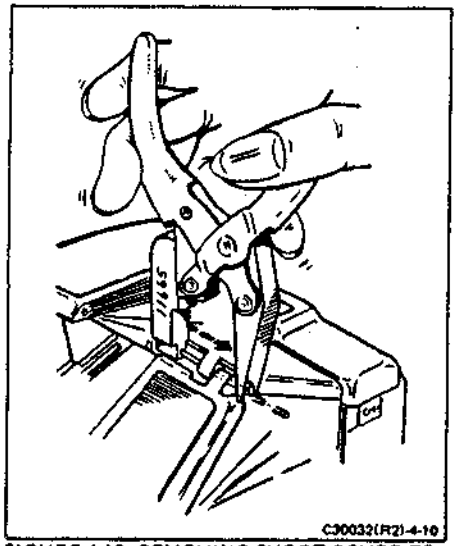


FIGURE 4-10 REMOVING SHORT-COVER-TO-MIRROR COVER HINGE PINS

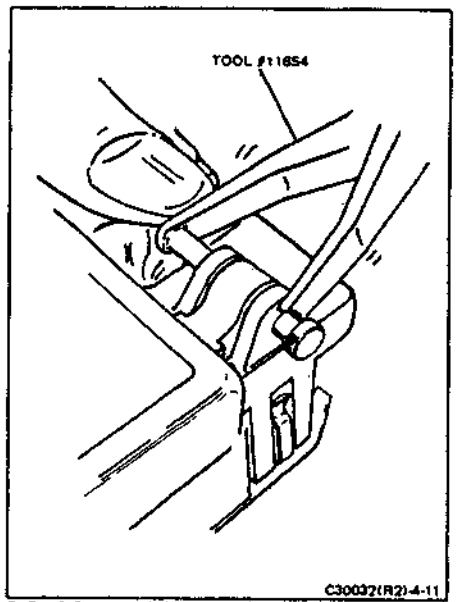


FIGURE 4-11 REMOVING MIRROR COVER/ INNER FRAME HINGE PINS

c. Use a 0.096 tap and cut threads in the drilled hole.

d. Secure the boot retainer tab with a 0.096 3/32" round head brass screw.

e. Replace the light seal and either heat stake or glue it in position.

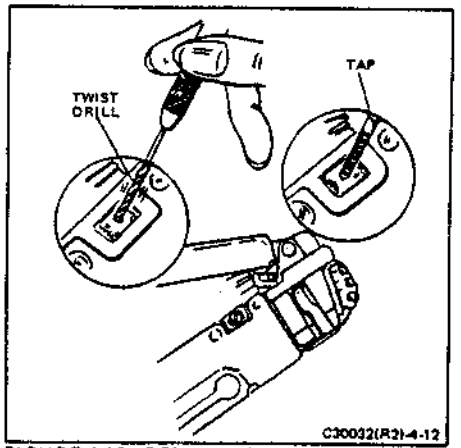


FIGURE 4-12 REPAIRING DAMAGED BOOT RETAINER TAB

f. Paint or mark a white dot under the light seal to warn that a screw fix has been made (Figure 4-13).

g. If the repair has to made on the gear train side, the entire gear assembly first has to be removed.

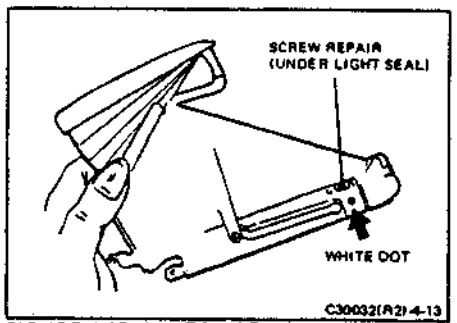


FIGURE 4-13 WHITE DOT INDICATION OF SCREW REPAIR TO BOOT RETAINER TAB

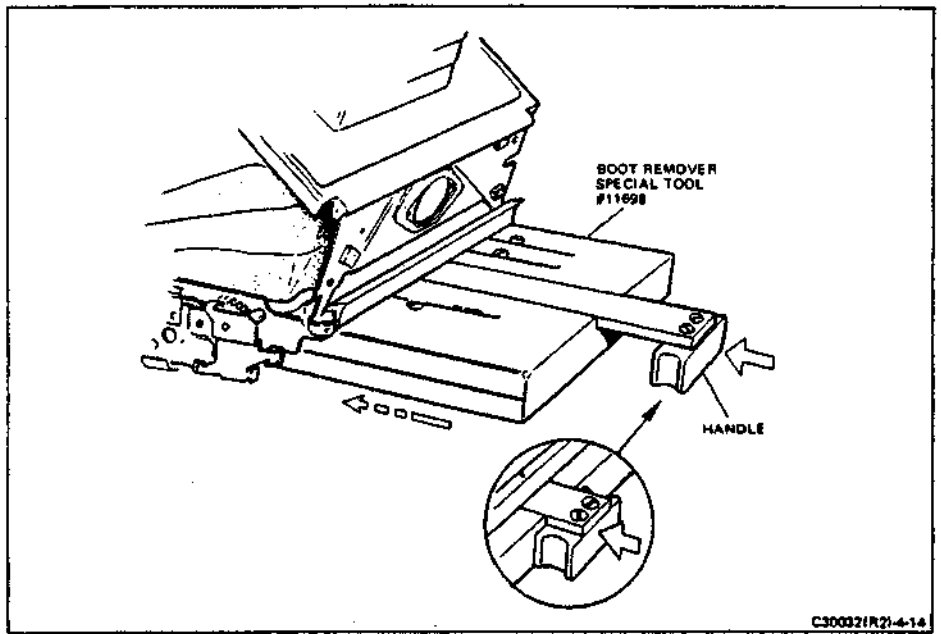


FIGURE 4-14 BOOT REMOVAL TOOL

Caution: Before continuing with step 12, look for a white dot painted under the light seal on the upper right side of the bottom plate (Figure 4-13). If the dot is there, it means that a previously broken boot tab has been repaired by using a screw. In this event, you cannot snap off the retainer as described in the next paragraph.

12. Referring to Figure 4-14, note orientation of the handle; this must be as shown to prevent damage to tool and/or camera. Insert boot remover, Special Tool #11698, into the film compartment of the camera. Note that the plunger handle is out, away from the body of the tool. Be sure that the body of the tool is fully seated in the film compartment.

    NOTE: If the Special Tool #11698 is not available, follow the method below.

    a. Identify the second gear from the motor end of the gear train. Rotate this gear in a counterclockwise direction until the pick slide reaches the end of its travel and is captured by the pick latch.

    b. Refer to Figure 4-15. Use a narrow-blade jeweler's screwdriver. While pulling the corner of the mirror cover away from the frame, depress the boot retainer tab to clear the retaining stud. Release the pressure as soon as the tab snaps free.

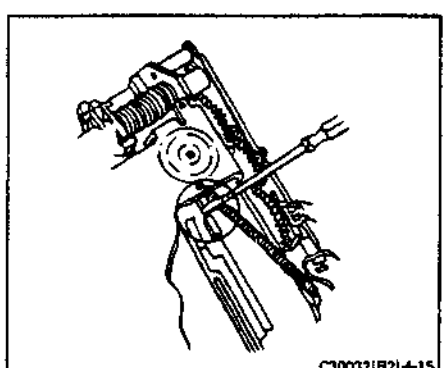


FIGURE 4-15 RELEASE BOOT RETAINER TAB

    c. Rotate the gear further in the counterclockwise direction until the pick slide is released and snaps forward.

    d. Use the jeweler's screwdriver and, while pulling the boot away from the frame, pry off the second tab.

13. Firmly push the boot remover handle in to free the boot from the inner frame tabs. Push until a click is heard and the tool bottoms.
14. Grasp the boot and gently pull it up, first one side, then the other away from the tabs.
15. Pull the plunger handle out and remove the tool from the camera.
16. Slide the erecting link to the end of its slot and disengage the link. Remove boot complete with erecting link connected, being careful not to scratch the surface of the Fresnel screen.

Installation

1. Insert the roller on the end of the erecting link through the hole at the end of the curved slot and slide the link into position.
2. Hold the cover assembly in such a position that the S6 actuator hangs straight down.
3. Lower the housing so that the free-hanging actuator passes through the cutout in the inner-frame assembly toward the S6 contacts (see Figure 4-16).

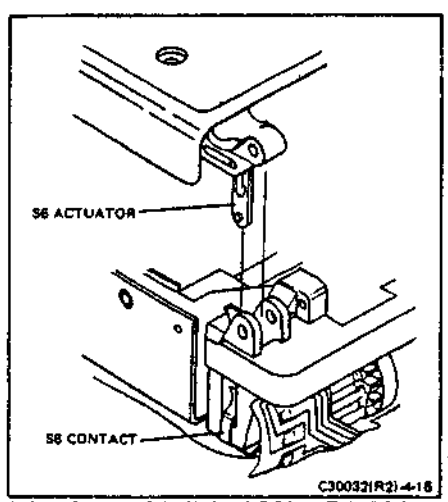


FIGURE 4-16 LOCATION OF S6 ACTUATOR LINK

4. Reinstall the two mirror-cover-to-inner-frame hinge pins.
5. Snap the boot retainer over the tabs on the inner frame (see Figure 4-17).
6. Reinstall the two mirror-cover-to-short-cover hinge pins.
7. Install and tighten the two shutter-bracket-to-boot-retainer screws.
8. Align the shutter locating pins with their holes (Figure 4-18) and install the four mounting screws.

    NOTE: On black plastic base shutters, only the upper two holes on the shutter hinge bracket are used for locating purposes. (There are no locating pins.)

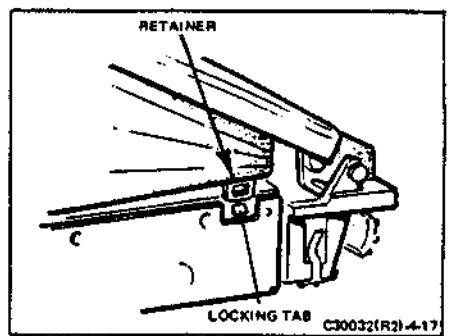


FIGURE 4-17 BOOT RETAINER

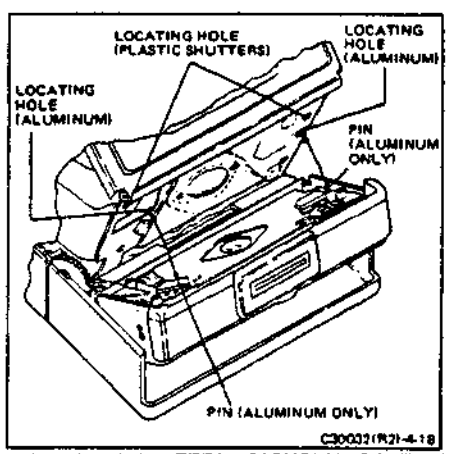


FIGURE 4-18 SHUTTER ASSEMBLY LOCATING PINS – ALUMINUM AND PLASTIC BASE SHUTTERS

9. Identify the second gear from the motor end of the gear train. Rotate this gear in a counterclockwise direction until the mirror is in the picture-taking position (up).
10. Install and tighten the inner-frame-to-boot retainer screws.
11. Check the camera for proper operation at this point.
12. Reinstall the bottom cover. Install and tighten the four screws. Reinstall the gear train cover.
13. Again check the camera for proper operation and for light leaks.
14. Replace the front cover by squeezing the sides of the cover just enough to engage the pivot points.
15. Check the camera for proper operation.
16. Replace the decorative leather covering on the bottom cover.

C. S6 ACTUATOR

The S6 actuator is a mechanical link which closes switch S6 when the camera is erected. This, in turn, closes the primary battery circuit. The actuator is not accessible when the camera is assembled and, therefore, is not frequently subjected to damage by mishandling. It is, however, subject to wear and fatigue and, together with the switch itself, is suspect whenever battery power fails to reach the camera's electronic circuitry. The following procedures explain the method of removing and reinstalling the S6 actuator.

Removal

1. Erect the camera to picture-taking configuration.
2. Open and remove the front cover.
3. Remove the decorative leather covering from the bottom cover.
4. Remove the four bottom-cover retaining screws.
5. Remove the bottom cover. (Refer to bottom cover removal procedures in paragraph B, steps 5 and 6.)
6. Remove the inner frame to boot retainer screws (refer to Figure 4-8).
7. Remove the mirror cover to inner frame hinge pins, using Special Tool #11654 (Figure 4-11).
8. Remove the mirror cover assembly. (Refer to the procedures in paragraph B.)
9. Remove the S6 actuator (Figure 4-19) from the mirror cover by driving out the actuator cam pin with a small drift pin.

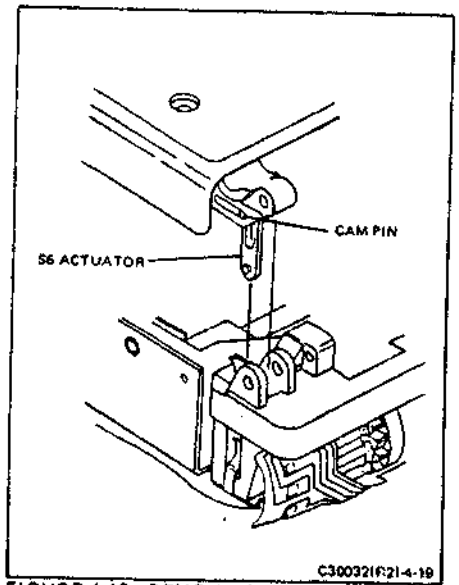


FIGURE 4-19 REMOVING S6 ACTUATOR

Installation

1. To install the replacement actuator, place the actuator in position in the slot of the mirror-cover hinge. (The actuator is symmetrical and can be installed in any position.)
2. Reinsert the actuator cam pin and press it into place.
3. Insert the erecting link into the roller track.
4. Hold the cover assembly in such a position that the S6 actuator hangs straight down.
5. Lower the housing so the free-hanging actuator passes through the cutout in the inner frame assembly toward the S6 contact. (See Figure 4-19.)
6. Snap the boot retainer over the tabs on the inner frame.
7. Reinstall the two mirror-cover-to-inner-frame hinge pins.
8. Identify the second gear from the motor end of the gear train. Rotate this gear in a counterclockwise direction until the mirror is in a picture-taking position.
9. Install and tighten the inner-frame-to-boot retainer screws.
10. Again rotate the gear train in the counterclockwise direction until the Fresnel carrier returns to the viewing position.
11. Check the camera for proper operation.
12. Reinstall the bottom cover. Install and tighten the four screws.
13. Replace the front cover by squeezing the sides of the front cover just enough to engage the pivot points.
14. Check the camera for proper operation.
15. Replace the decorative leather covering on the bottom cover.

D. ERECTING LINK

A single link is employed to secure the camera in the picture taking configuration when the camera is manually opened to that position. Since the angular relationship of the mirrors, lenses, and all other optical components is critical, a broken or distorted erecting link can seriously affect the camera's photographic performance.

A broken erecting link spring can also adversely affect the optical system because the link will not be firmly held in its proper position. If there is evidence of mechanical distortion or looseness of the erecting link, the link must be replaced. The following paragraphs describe the correct procedures:

Removal

1. Erect the camera to picture-taking configuration.
2. Open and remove the front cover.
3. Carefully peel the leather from the bottom cover.
4. Remove the four screws from the bottom cover.
5. Remove the bottom cover. (Refer to bottom cover removal procedures in paragraph B, steps 5 and 6.)
6. Peel the leather from the mirror cover assembly.
7. Refer to Figure 4-20. Remove the two link-retaining screws.
8. Remove the boot-retaining screw indicated in Figure 4-20.

   NOTE: New cameras have rivets instead of retaining screws. The rivet need not be removed when removing the erecting link.

9. Release the erecting link from the open-camera locked position.
10. Slide the spring end of the link toward the end of the cover and lift the spring end of the link from its mounting position.
11. Slide the opposite end of the link to the end of its slot so that the roller can be withdrawn through the hole provided for the purpose.

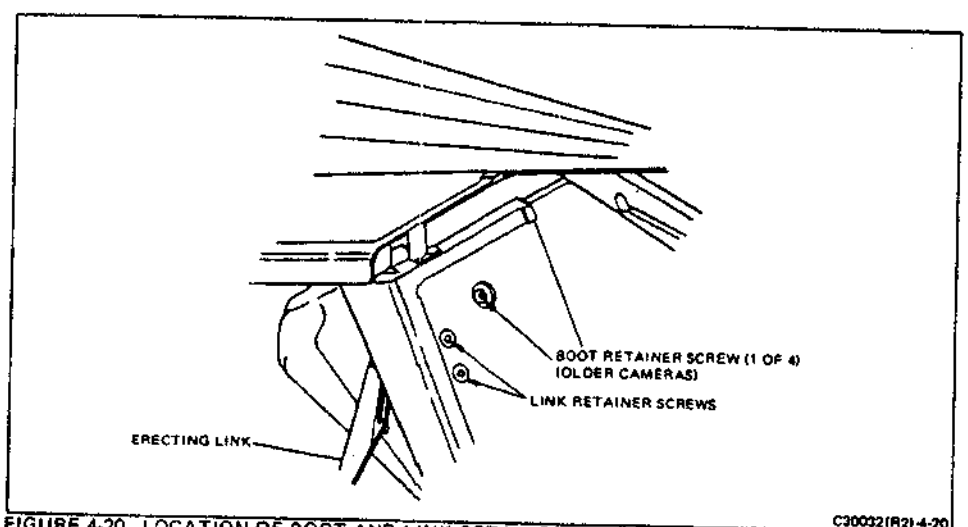


FIGURE 4-20 LOCATION OF BOOT AND LINK RETAINER SCREW

Installation

1. If the erecting link is undamaged but a new spring is needed, refer to Figure 4-21. Note that the coiled portion of the spring snaps over a small projection on the link assembly.

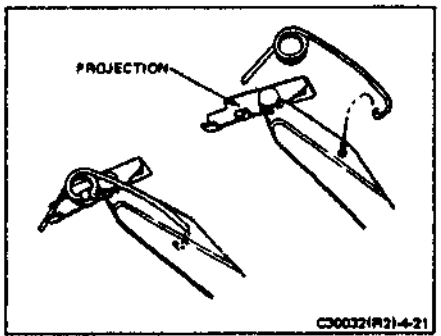


FIGURE 4-21 ERECTING LINK SPRING INSTALLATION

2. Insert the link roller into the hole at the end of the curved slot and slide the link into position.
3. The hinged foot at the spring end of the link must be positioned under the edge of the boot. Use the blade of a small screwdriver to lift the boot just enough to insert the link.

   NOTE: The following step pertains only to older cameras. Newer cameras use rivets instead of screws to hold the boot. Therefore, on newer cameras, install two screws to secure the erecting link.

4. Install the three screws through the mirror cover to secure the erecting link (Figure 4-20).
5. Replace the leather on the mirror cover.
6. Slide the bottom cover into place.
7. Install and tighten the four cover retaining screws.
8. Check the camera by performing the Optical System procedures in Section 3.
9. Replace the leather on the bottom cover.
10. Install the front cover.

Repairs/Adjustments

1. Erecting Link Clearance

If the erecting link is sticky and does not slip into the lock position, most people tend to pull harder on the viewfinder cap while squeezing the sides of the camera. This makes the problem worse since the necessary clearance for the link may be lost. When you have a camera with a complaint of this nature, perform the following procedure:

a. First, examine the erecting link assembly to be sure that no other problem (weak spring, twisted link, binding of link in track) is contributing to the sticky erecting link travel.

b. With the camera fully erected, slip special spacer #705566 under the edge of the detent clip as shown in Figure 4-22. The spacer will snap into place under the edge of the clip and will provide the needed clearance between the lower camera back assembly and the bottom cover.

   NOTE: Early cameras do not have the detent clip shown in Figure 4-22 so the spacer cannot be installed. However, these cameras should not exhibit this clearance problem anyway. Also, new camera models have a modified detent clip which eliminates the clearance problem.

2. Detent Clip Mounting

The detent clips in early cameras are riveted in place with detent pins #705762. Newer cameras have the detent clip staked in place over two tenons which are a part of the bottom plate assembly.

If a detent clip on an early camera must be replaced, use rivets #705062 in place of the detent pins.

If a detent clip on a newer camera must be replaced, drill out the two tenons with a 1/16" drill and use rivets #705062 to secure the clip. (The rivet must be positioned so the rivet head is in the film compartment.)

Caution: Be certain that no foreign matter falls into the camera during the drilling.

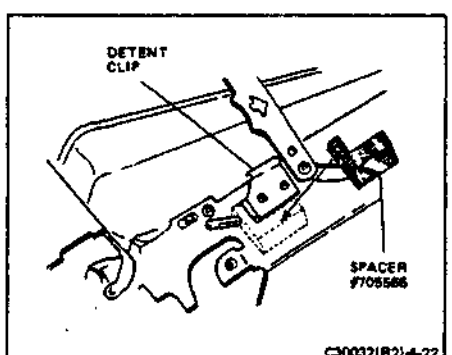


FIGURE 4-22 INSTALLING ERECTING LINK SPACER

E. VIEWFINDER SYSTEM/SHORT COVER ASSEMBLY

The SX-70 is a single-lens reflex camera and, as such, the viewfinder system involves the picture-taking lens, the reflex viewing mirror, the Fresnel viewing screen, and the eyelevel optical system. The latter system is housed in the folding short cover assembly. In the short cover assembly, the optical components consist of the eyelens, a concave mirror, and a wafer lens assembly. These optics function to bring the Fresnel image into sharp focus for the photographer. The optical path is indicated in Figure 4-23.

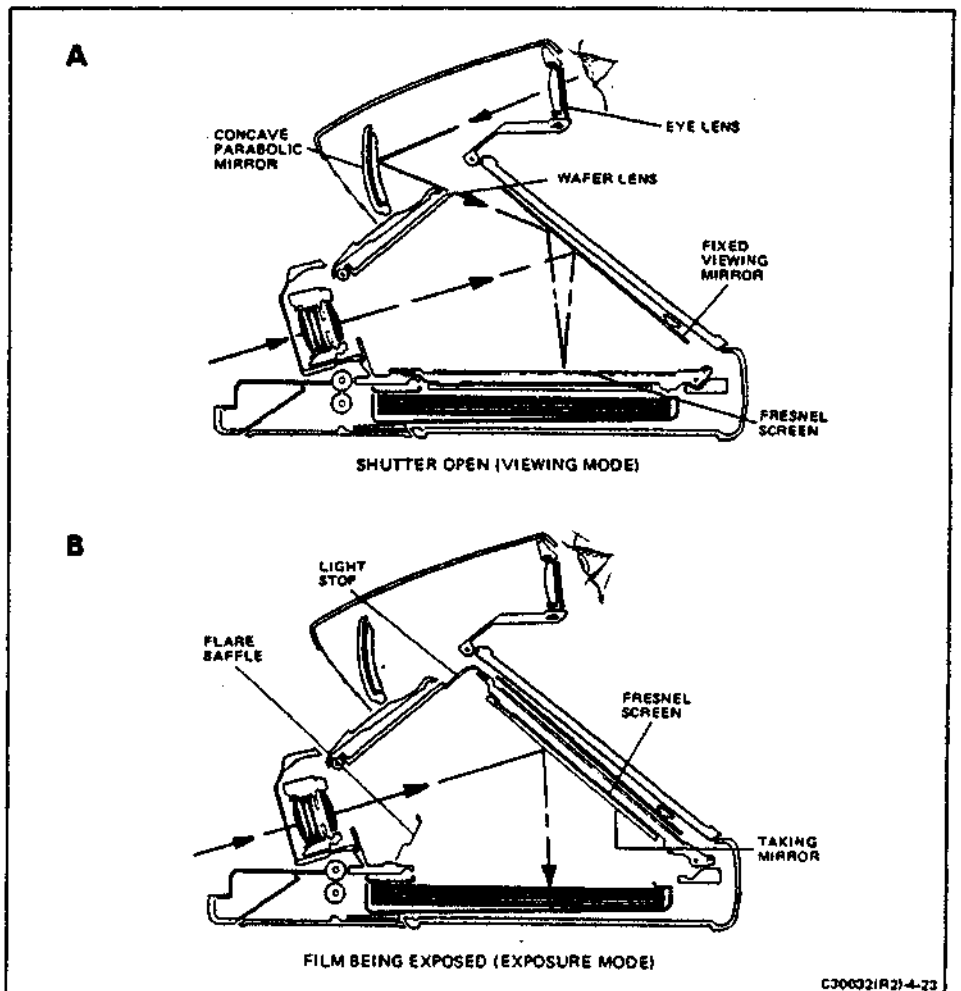


FIGURE 4-23 SX-70 OPTICAL SYSTEM

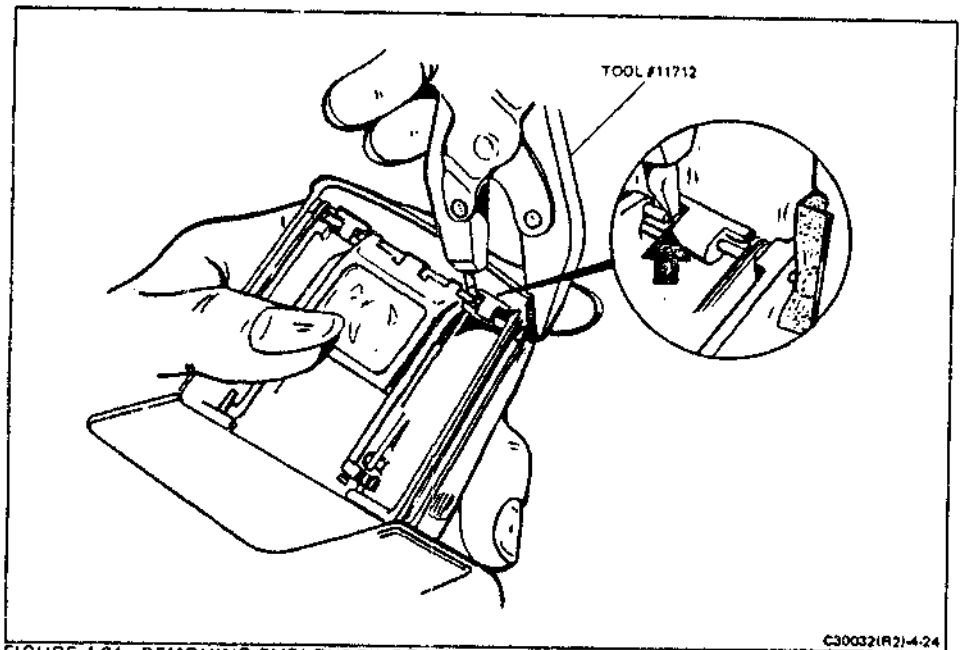


FIGURE 4-24 REMOVING EYELENS PIVOT PIN

A visual inspection of the short cover assembly will reveal any defective components. If the optical components are damaged or displaced, it will be impossible to obtain a sharp view of the Fresnel image.

The following paragraphs describe the removal and replacement of the individual components.

1. Eyelens/Housing Assembly

Removal

If the eyelens has been damaged, its lens/housing assembly can be removed and replaced without removing the other viewfinder components.

a. Extend the camera to picture-taking configuration.

b. Using Special Tool #11712 (Figure 4-24) press out either end of the three-piece pivot pin until the pin emerges far enough to allow the insertion of a jeweler's screwdriver underneath the head of the protruding pin. Pry the pin all the way out with the screwdriver.

NOTE: In the following step, the eyelens torsion spring will be released. Do not lose the spring. (Retain it for reuse.)

c. There is sufficient slack in the lens erecting system to permit tilting the eyelens housing a few degrees. Tilt the housing to release the center pivot pin from the assembly.

d. Slide the eyelens housing toward the hinged ends of the eyelens links until the pivot studs on the lens housing line up with the large clearance holes at the ends of the slots in the links.

e. Tilt the erecting assembly slightly and release first one and then the other pivot stud, and remove the lens housing assembly.

f. Remove and retain the center section of the three-piece pivot pin and the torsion spring.

Installation

NOTE: Before installing the eyelens assembly, you must be certain that it is compatible with the rest of the viewfinder system. Most cameras have a wafer lens and split image Fresnel. However, there are still some cameras with a stigmatic pupil and plain Fresnel. These latter models have an eyelens which lies flat in the housing. The split image systems have an eyelens which is mounted in the housing at a 3° tilt. When replacing the eyelens, the 3° tilt assembly can be used with either the split image Fresnel system or the plain Fresnel system.

a. The lens and its housing is replaced as a unit. Pass the two eye lens assembly pivot pins through the holes in the eyelens links, and slide the assembly down to the ends of the slots.

b. Locate the two spring ends in the housing as shown in Figure 4-25.

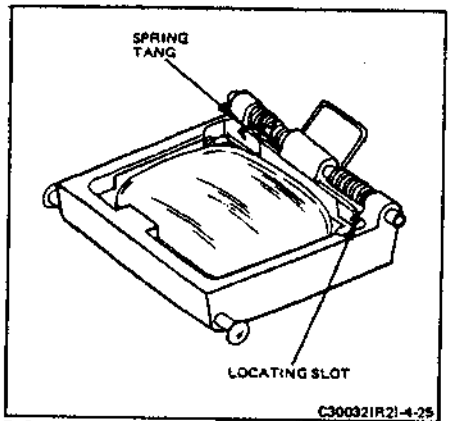


FIGURE 4-25 EYELENS TORSION SPRING

c. Lay the lens with the eyelens links flat against the camera body and install the torsion spring and center section of the pivot pin.

d. Referring to Figure 4-26, line up the ends of the center pivot pin section with the grooves in the viewfinder cap. Torsion the spring and at the same time, press the lens housing down so that the ends of the pivot pin rest in the grooves.

e. Hold the lens housing in place and insert the two remaining sections of the three-piece pivot pin.

f. Gently tap the pins into position so the ends of the pins are flush with the outside of the viewfinder cap.

Repairs/Adjustments

There have been isolated instances of eyelens/housing assembly pivot pins breaking. These defects have been traced to a single batch of material of insufficient strength. These pins are identifiable by a mold number P91 on the hinge. If you see any of these units, replace the eyelens assembly.

2. Concave Mirror Assembly

The concave mirror is the optical device which bends the image rays from the Fresnel viewing screen to direct them to the eyelens. If the mirror is displaced or damaged, it will be impossible to obtain a proper view of the Fresnel image. Replace the concave mirror and housing in the following manner:

Removal

a. Open the camera to its picture-taking configuration.

b. Using Special Tool #11712 (Figure 4-24) press out either end of the three-piece pivot pin until the pin emerges far enough to permit inserting a jeweler's screwdriver underneath the head of the protruding pin. Pry out the pin with the screwdriver.

NOTE: In the following steps, a number of separate components will be released. To prevent loss of these items, hold the assembly together with one hand while removing pins with the other.

c. Once the pivot pins are removed, slowly raise the eyelens assembly. Remove the viewfinder cap by twisting the cap from the concave mirror studs.

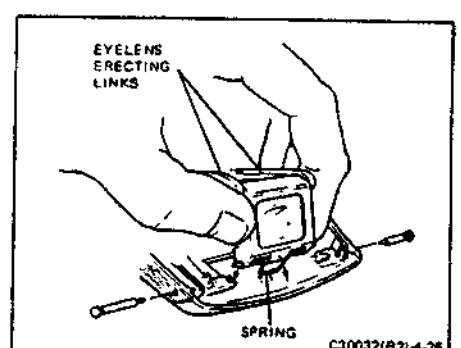


FIGURE 4-26 INSTALLING SPRINGS

d. Holding the concave mirror in place, bring the two rear projections of the shade blade assembly forward until the two tabs leave the two slots at the front of the short cover. Remove the shade blade assembly.

e. Allow the concave mirror housing to swing back until the spring tension is removed and the housing can be lifted from the viewfinder.

Installation

a. If the spring just removed is in good condition, install it on the replacement concave mirror housing as shown in Figure 4-27. Otherwise, install a new spring.

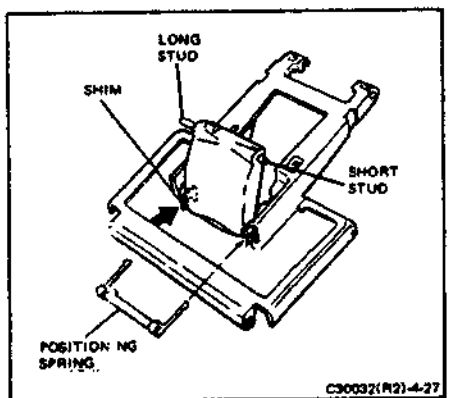


FIGURE 4-27 ORIENTATION OF SHIM AND POSITIONING SPRING

b. The mirror housing has two short studs on one side and two long studs on the other. Note that the flat side of the studs line up with the slots in the housing. (Refer to Figure 4-27.) Insert the lower short stud into its slot on the left side of the short cover.

c. Lower the bottom stud into the right side slot making certain that the spring lies between the two vertical barriers in the short cover and does not interfere with the swing of the mirror housing.

d. Insert the two tabs of the shade blade assembly into the slots in the short cover and swing the assembly down until the two holes line up with the pivot pin holes in the viewfinder housing. The front edge of the shade blade assembly will raise the concave mirror housing to the vertical position. Hold the blade assembly down.

e. Hold the viewfinder cap at an angle and insert the upper short stud on the mirror housing into the curved slot in the left hand track.

f. Swing the viewfinder cap around until the long stud of the mirror housing will enter the curved slot of the right track. The hooked end of the spring must be outside the track.

g. Two hooked tangs on the front upper edge of the shade blade assembly engage two projections inside the front edge of the viewfinder cap. Tilt the cap downward so that is folds down the mirror housing and, at the same time, slide the cap rearward to pick up the shade blade tabs. Lower the cap until the pivot-pin holes are correctly aligned.

h. Align the center section of the three-piece pivot-pin assembly (with the eyelens assembly and the torsion spring in place) with the pivot-pin holes in the shade blade assembly and the viewfinder cap. Install the two outer pivot pin sections.

Repairs/Adjustments

Misadjustment of the concave mirror is usually evidenced during the exit pupil check. (Refer to Section 3 for exit pupil check procedure.)

a. Exit Pupil Vertical Alignment

(1) If the exit pupil image seen in the gage is too high, turn the concave mirror adjusting screw (Figure 4-28) clockwise.

NOTE: A slightly heated spline Bristol screwdriver #11753 should be used to turn the sealed screw.

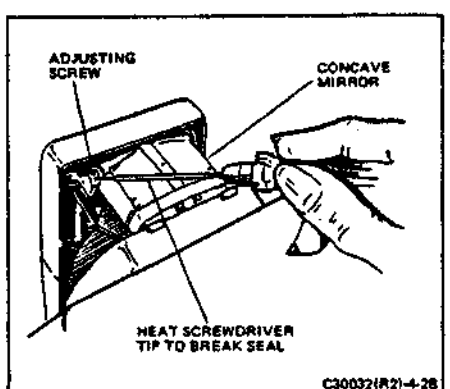


FIGURE 4-28 CONCAVE MIRROR ADJUSTING SCREW

(2) If the exit pupil image seen in the gage is too low, turn the concave mirror adjusting screw counterclockwise.

b. Exit Pupil Horizontal Alignment

(1) If the exit pupil image seen in the gage is too far to the right, install a shim at the right-hand pivot point of the mirror. (Refer again to Figure 4-27.) Two shims are available, both with the same part number, 705888. One shim is red and is 0.036 inches thick and the other shim is blue and is 0.040 inches thick. Use the shim which brings the exit pupil image to the center of the gage.

(2) If the exit pupil image is too far to the left as seen in the gage, install a red or blue shim at the left-hand pivot point of the mirror.

3. Eyelens Erecting Links

The eyelens erecting links are a part of the eyelens assembly erecting system. They are removed and replaced in the following manner:

Removal

a. Using Special Tool #11665, remove the mirror-cover to short-cover hinge pins (Figure 4-29).

b. Remove the eyelens housing as described previously.

c. Lift one of the erecting links until the flat on its retaining stud is aligned with the slot in the retainer and lift out the link.

d. Remove the second link in the same manner.

Installation

a. Install the replacement links by aligning the flats with the slots, inserting the studs into the retainers, and rotating the links.

b. Reassemble the viewfinder as described previously.

c. Perform the Viewfinder Quality checks prescribed in Section 3.

4. Conversion of Plain Fresnel to Split Image System

Early cameras were manufactured with a plain Fresnel for viewing the scene to be photographed. This system was later improved by the introduction of the split image Fresnel screen. (See Sections 1 and 2 for information on the newer Fresnel screens with a split image circle.) Early cameras can be converted to the split image style by making several modifications. The modifications include the addition of a new short cover assembly

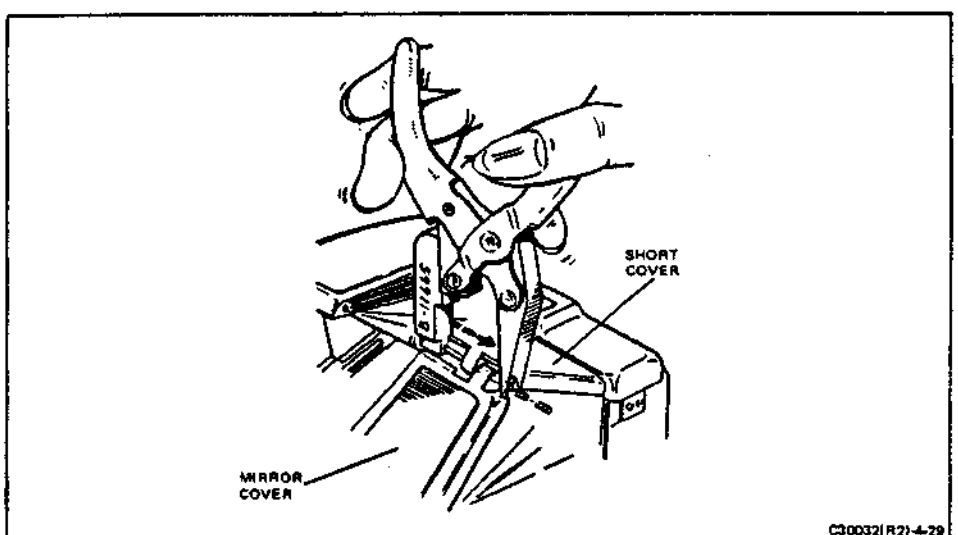


FIGURE 4-29 REMOVING SHORT-COVER-TO-MIRROR-COVER HINGE PINS

which has an updated concave mirror, a 3° tilted eyelens, and a new wafer lens in place of the old stigmatic pupil. To accommodate the new short cover, the cutout in the boot must be altered as explained in paragraph a below. Then, the Fresnel carrier is replaced with a new split image unit as described in the Fresnel Carrier section.

a. Boot Modification

To accommodate the new wafer lens assembly, the cutout in the old style boot must be enlarged. Do this as follows (after removing the short cover assembly), using Special Tool #363361 (Figure 4-30).

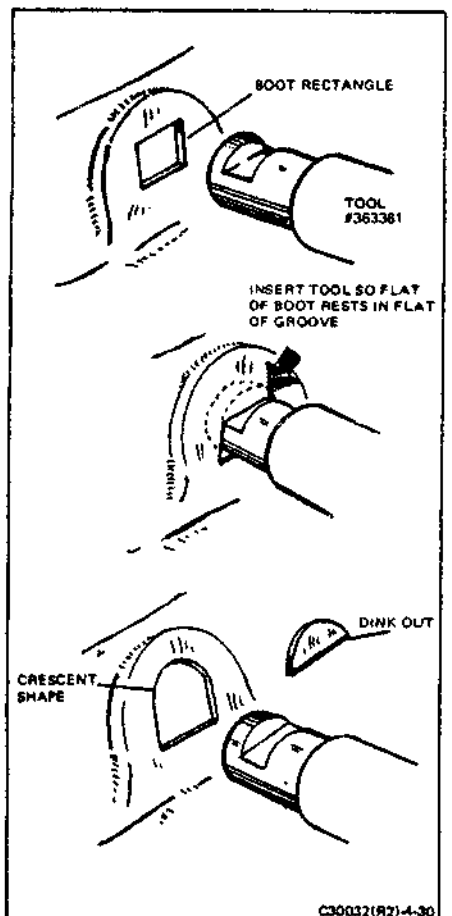


FIGURE 4-30 USING THE BOOT TRIM GUN

(1) Insert the top of the tool – slot uppermost – just under the upper edge of the rectangular hole in the boot.

(2) Press the tool against the upper edge of the boot hole so that the vertical edge of the rear of the tool slot butts against the boot.

(3) Squeeze the tool trigger slowly, keeping the tool aligned and cut out the piece of boot.

(4) The hole should look like the drawing with a rectangular bottom edge and a crescent-shaped top.

b. Parts Matchups

Remember that the split-image Fresnel is effective only with the addition of the wafer lens, new concave mirror, and 3° tilted eyelens. (These three items may be installed as part of a new short cover assembly.) Examine the camera to be certain that the proper parts are installed. Refer to the Configuration Control section for the part numbers of these new items.

c. Wafer Lens Light Leak Possibility

The edges of early wafer lens assemblies had to be painted with Kodak Brushing Lacquer #4 to avoid the possibility of a light leak through the boot. However, newer cameras employ boots which have blinders on them. These blinders prevent light leaks from the wafer lens. Therefore, on these cameras only, there is no need to paint the edges of a replacement wafer lens assembly. On cameras with no boot blinders, paint the two edges of a replacement wafer lens before installing it in the short cover. Examine whether the wafer lens must be painted.

5. Short Cover Assembly (One Piece Replacement)

Removal

a. Erect the camera.

b. Open and remove the front cover.

c. At the back side of the shutter mounting bracket, remove four screws which secure the shutter (Figure 4-31).

d. When the shutter is loose, lay it aside, being certain not to strain the multi-wire cable.

e. Remove the two short-cover-to-mirror-cover hinge pins, using Special Tool #11665. Insert the tool through the separation between the short cover and the mirror cover (Figure 4-26).

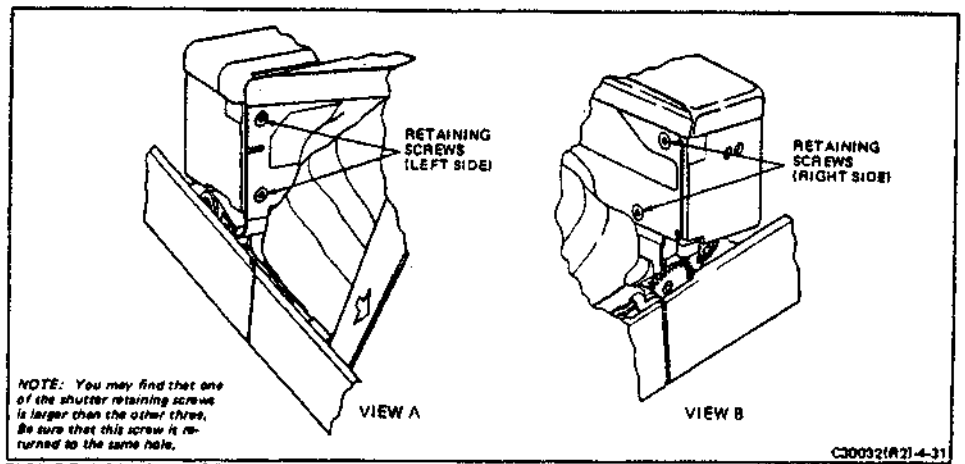

RETAINING SCREWS (LEFT SIDE)
RETAINING SCREWS (RIGHT SIDE)
NOTE: You may find that one of the shutter retaining screws is larger than the other three. Be sure that this screw is returned to the same hole.
VIEW A
VIEW B
C30032(R2)-4-31

FIGURE 4-31 SHUTTER MOUNT RETAINING SCREWS

f. Collapse the erecting link and pull forward the short cover assembly.

g. Remove the two shutter hinge bracket-short-cover pins with Special Tool #11654 (Figure 4-32). Remove the short cover assembly.

Installation

a. Align the new short cover assembly on the shutter hinge bracket and secure the two by replacing the two pins which hold them together (Figure 4-32). Be certain that the two assemblies are flush.

b. Align the short cover with the mirror cover hinges and secure the two by replacing the two hinge pins (Figure 4-29).

c. Align the shutter on the mounting bracket and secure it by installing the four screws previously removed (Figure 4-31).

d. Install the front cover assembly.

F. SHUTTER ASSEMBLY

To physically separate the shutter from the camera body, it is necessary to disconnect the multi-wire ribbon cable from the flex circuit. Because this involves a critical soldering operation, any repairs that can be performed with the soldered connections in place should be done in that manner. If the camera malfunction is traced to the shutter and it is determined that the entire assembly must be replaced, perform the replacement as follows:

Caution: A failure mode caused by a static charge on a loose shutter (configuration M or earlier) has been encountered. Before removing a shutter from a camera, note the current drawn at the end of a cycle. It must be zero. If not, it could be an indication that the PNP transistor on the substrate (T.I. Ceramic only) has failed by not being turned off.

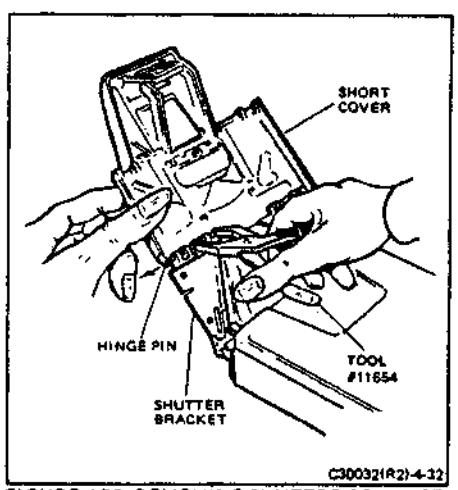


FIGURE 4-32 REMOVING SHUTTER BRACKET/ SHORT COVER HINGE PINS

Removal

1. Erect the camera to picture-taking configuration.
2. Open and remove the front cover.
3. Carefully peel the leather from the bottom cover.
4. Remove the four screws from the bottom cover.
5. Remove the bottom cover as previously instructed.

   NOTE: Use only the miniature soldering iron specified for this task to guarantee the proper amount of heat applied to connections. (This may save the cable assembly.)

6. Refer to Figure 4-33. Starting with lead No. 1 of the cable, insert the point of a sharp blade (a pointed blade Xacto knife is recommended) under the wire. The sharpened edge of the blade must be held so that it makes physical contact with the junction point of the wire lead and the solder pad of the flex circuit. Do not insert the point of the blade beyond lead No. 1.
7. By exerting a slight clockwise twist to the blade, apply upward pressure to the end of the lead.
8. While maintaining a steady upward pressure with the knife blade, bring the tip of the soldering iron into contact with the copper pad on the side of the soldered connection opposite the cable lead.
9. At the instant that the knife blade breaks the solder joint, remove the soldering iron. Hold the knife blade steady for a moment to allow the pad and the wire to cool.
10. Repeat steps 6 through 9 for each of the cable leads.

    Caution: Under no circumstances attempt to heat and remove more than one lead at a time.

11. Refer to Figure 4-34. Carefully spread one tab of the cable clamp just enough to permit removal of the cable retaining spring and slip the spring out of the clamp.
12. At the backside of the shutter mounting hinge bracket, remove the four screws which secure the shutter to the bracket. See Figure 4-31. Lift off the shutter.

Installation

NOTE: When changing a shutter, replace it with an N or P configuration only. Do not use M or earlier configurations. On old shutters, make only simple repairs (focus wheel replacement, trim assembly replacement, idler gear replacement, shutter front housing replacement, etc.). Major repairs should not be made on configuration M or earlier types. Replace these with N or P configuration shutters. All stocked shutters other than N or P types should be returned to Waltham Parts Dept. for credit. All bad shutters removed are salvageable. When installing new shutters, be sure they are compatible with the camera. The shutter hinge bracket, MCC, and front cover must correspond with the charts below ("Shutter/Camera Interchangeability").

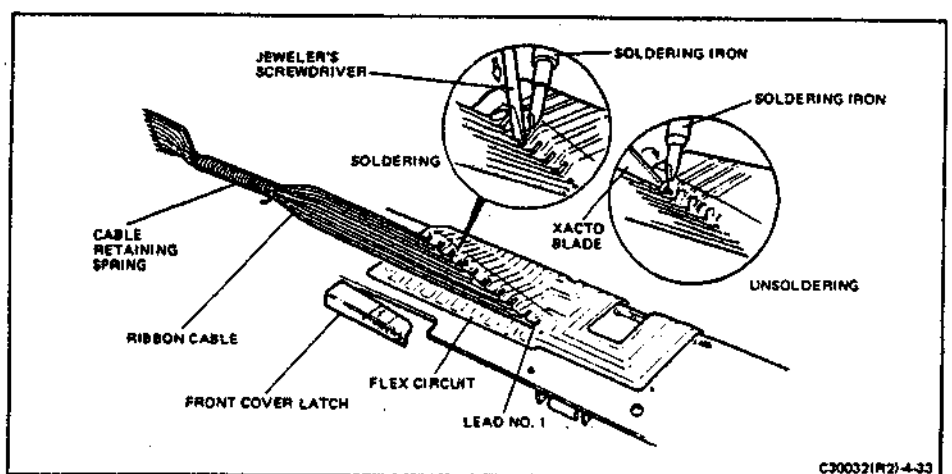


FIGURE 4-33 SOLDERING/UNSOLDERING RIBBON CABLE

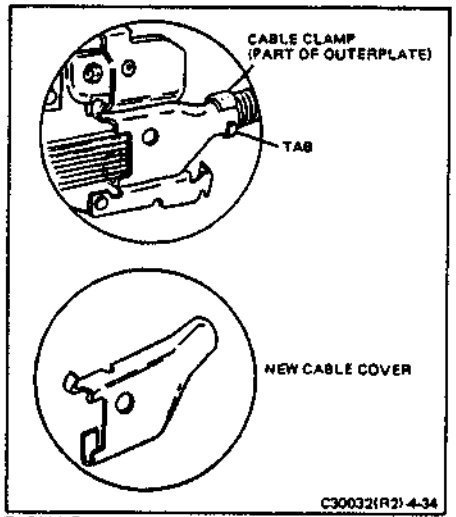


FIGURE 4-34 NEW CABLE COVER

1. Position the locating pins at the rear of the shutter in the correct holes in the hinge bracket and install the four retaining screws.

   NOTE: The new plastic shutter baseblock has no locating pins.

2. Dress the multi-wire ribbon cable in the direction of the flex circuit.
3. Locate the short projecting end of the cable retaining spring and the hole at the base of the clamp. Install the spring in the clamp in such a manner that the projection enters the hole in the clamp.
4. Crimp the clamp on the spring with just enough pressure to capture the spring. It does not have to be a tight joint.

SHUTTER/CAMERA INTERCHANGEABILITY

Basic Camera	Add New Shutter	MCC	Shutter Hinge Bracket	Front Cover Assembly	Wiring
10 Wire Flex	N-Recommended P-If necessary	705819 or 705888	705893	(Wide Cam)	Refer to Para. F, Section 4
8 Wire Flex	N or P	705819 or 705888	705893		Do not Solder PNP #4 Lead
7 Wire Flex	P	705819 or 705886 or 705901 or 705619 or 705982	705893		Direct

NOTE: Fairchild and TI shutters are interchangeable with the proper matchup of associated components.

FLEX CIRCUIT ID CHART

Flex Circuit*	MCC 705819 705886	MCC 705619 705901	705982	Counter 705403	Counter 705863	No. of Shutter Contacts
705329PP4	Yes	No	No	Yes	No	10
705329PP5	Yes	No	No	Yes	No	8
705329PP7	Yes	No	No	Yes	Yes	8
705329PP8	Yes	No	No	No	Yes	8
705442	Yes	Yes	No	No	Yes	7
705562	No	No	Yes	No	Yes	7

**Flex circuit part number is located between battery terminals on flex.*

5. At the flex circuit solder pads, check for good clean solder distribution. Heat and reflow the solder as necessary.

6. Properly orient the cable and dress the end of each lead so that it seats squarely in the center of its solder pad. Hold the cable in this position.

   NOTE: If the cable on the shutter has more or fewer leads than the number of pads on the flex circuit, refer to item 2 in the Repairs/Adjustments paragraph immediately following for the proper method of installing it.

7. Refer to Figure 4-33. Place the blade of a jeweler's screwdriver on top of the bare end of the No. 1 lead exactly at the point where the insulation begins. Press down firmly to create a positive heat sink. (This prevents the insulation from melting back on the lead.)

8. Apply the tip of the soldering iron so that it makes simultaneous contact with the pad and the tinned end of the wire lead.

9. Hold the iron in place just until the solder on the wire and the pad flow into a smooth joint.

10. Do not remove the screwdriver blade until the solder has cooled (one or two seconds). Continue until all leads are soldered.

11. Check the camera for proper operation. (Check all functional tests.)

12. Slide the bottom cover into place.

13. Install and tighten the four cover-retaining screws.

14. Squeeze the sides of the front cover just enough to engage the pivot pins.

15. Close the cover and check the camera.

Repairs/Adjustments

1. Stripped Shutter Mounting Holes

If the mounting hole of one of the shutter retaining screws should become stripped, complete the following steps when re-assembling the camera:

(a) Re-tap the stripped hole with a #2-56 bottoming tap.

(b) Use a #2-56 screw (#700950, modified Bristol repair screw) in place of the original retaining screw.

2. Connecting Cables to Flex Circuits

Since the SX-70 camera was first manufactured, several design changes have been made to the shutter assembly. These changes have resulted in cameras being in the field with different shutter configurations. The following procedures explain how to match cables to flex circuits. Also, refer to the table titled "Shutter Cable/MCC Interchangeability" to ascertain the appropriate shutter/MCC compatibility.

8 Wire Cable to 10 Pad Flex Circuit (Figure 4-35):

(a) To attach an 8 wire cable to the 10 pad flex circuit, separate the leads so that lead number 2 is pulled away from lead number 3. (Lead number 1 is the shortest lead.)

(b) Attach the shutter cable retaining spring to the clamp. The 8 lead cable has a hook, not the right angle lead of the 10 lead type.

(c) Hook in the spring and push it in as far as possible. Arrange the spring coils without stress and clamp them in the bracket (Figure 4-31).

(d) Mount the shutter by one screw.

(e) Arrange the 3rd, 4th, 5th, and 6th cable leads on the 5th, 6th, 7th, and 8th solder pads of the flex circuit (see Figure 4-32).

(f) Solder these 4 leads.

(g) Solder leads 1 and 2 to solder pads 1 and 2 on the flex circuit.

(h) Lastly, solder leads 7 and 8 to solder pads 9 and 10.

(i) Test shutter and camera action.

(j) Finish mounting shutter.

SHUTTER CABLE/MCC INTERCHANGEABILITY

MCC	SHUTTER				
	10 or 8 Lead FC Phase I	7 Lead FC Phase IA	7 Lead FC Phase II	8 Lead TI Phase I	7 Lead TI Phase II
705819-F	Yes	Yes	Yes	No	Yes
705817-TI	No	No	No	Yes	No
705886-TI	Yes	Yes	Yes	No	Yes
705901-TI or 705619 or 705982	No	Yes	Yes	No	Yes

Fairchild Phase I — G thru M
Texas Instrument Phase I — G thru L
Fairchild Phase IA — N
Fairchild Phase II — P
Texas Instrument Phase II — P

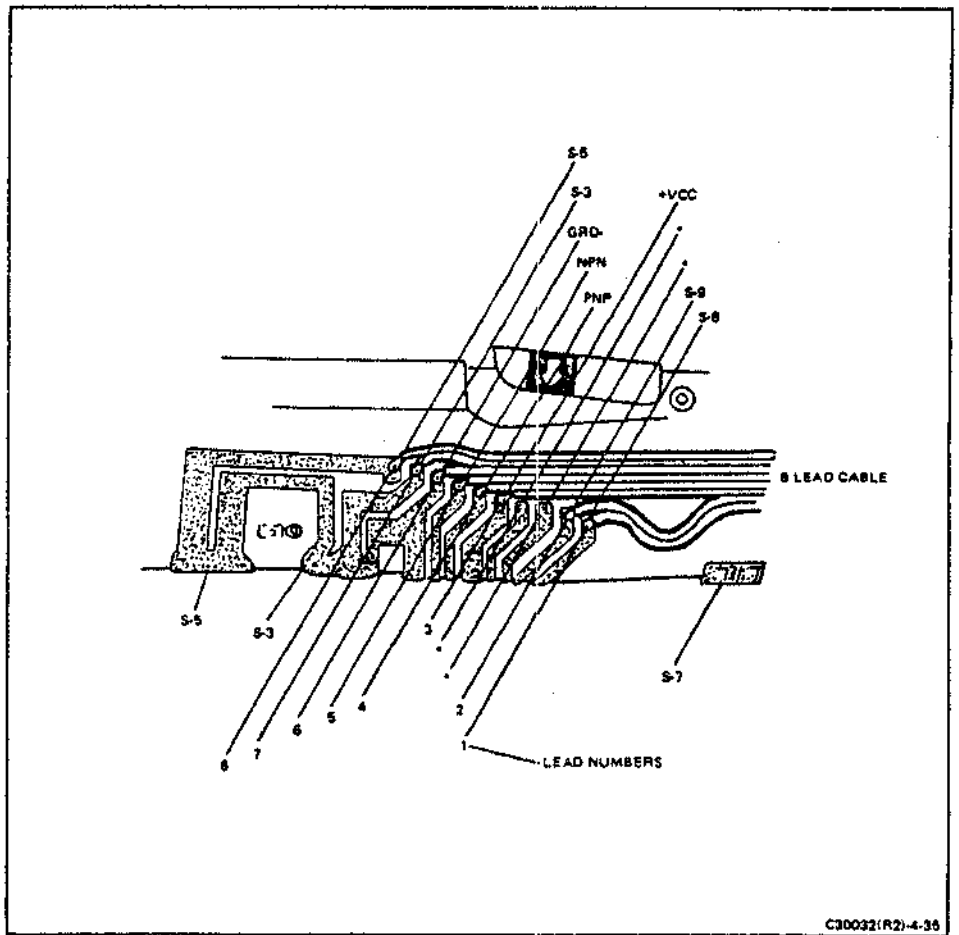


FIGURE 4-35 CONNECTING 8 WIRE SHUTTER CABLE TO 10 PAD FLEX CIRCUIT

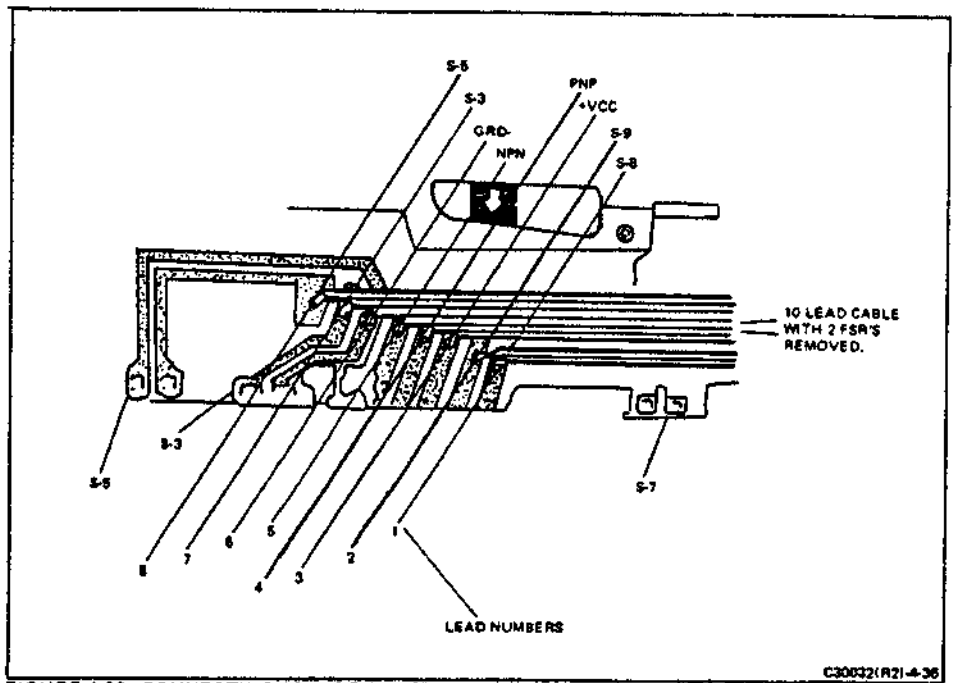


FIGURE 4-36 CONNECTING 10 WIRE SHUTTER CABLE TO 8 PAD FLEX CIRCUIT

10 Wire Cable to 8 Pad Flex Circuit (Figure 4-36):

(a) Count the shortest cable wire as lead No. 1 and remove lead wires 3 and 4.

(b) Attach the shutter cable retaining spring to the smaller hole in the cable bracket. Hold the spring without stress and clamp it in the bracket.

(c) Mount the shutter with one screw.

(d) Solder leads 1 and 2 to the number 1 and 2 solder pads on the flexible circuit.

(e) Solder the remaining leads to their same numbered flexible circuit pads.

(f) Test shutter and camera operation.

(g) Finish mounting shutter.

7 Wire T.I. Cable to 8 Pad T.I. Flex Circuit (Figure 4-37):

To use a 7 wire T.I. shutter with an 8 pad T.I. flex circuit, do not make a connection to the PNP lead (identified as the #4 lead on Figure 4-37) of the flex circuit. Refer to table – "Shutter/Cable Interchangeability" for proper cable/MCC match-up.

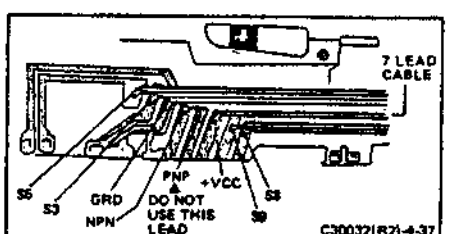


FIGURE 4-37 CONNECTING 7 WIRE SHUTTER CABLE TO 8 PAD FLEX CIRCUIT

7 Wire Cables to 10 Pad Flex Circuits:

The method for connecting a 7 wire cable to a 10 pad circuit is shown in Figure 4-38. Be sure to connect the leads to the terminals as shown in the illustration.

3. Mid-Cycle Shutdown

Some shutters have exhibited a mid-cycle shutdown which has been traced to motor noise. T.I. shutters without motor capacitors are most susceptible to this problem. The installation of a capacitor between the VCC terminal and ground on the shutter (Figure 4-39"A") suppresses noise and reduces the problem. If after installing the capacitor the mid-cycle shutdown persists, install a second capacitor between S6 and the counter (Figure 4-39"B"). Any suitable commercial tantalum 0.68 mfd capacitor may be used on the substrate and any suitable subminiature commercial ceramic 0.1 mfd may be used on the counter. These parts may be ordered from the Waltham Parts Department under the following numbers.

0.68 mfd Tantalum Capacitor – #705795
0.10 mfd Ceramic Capacitor – #705699

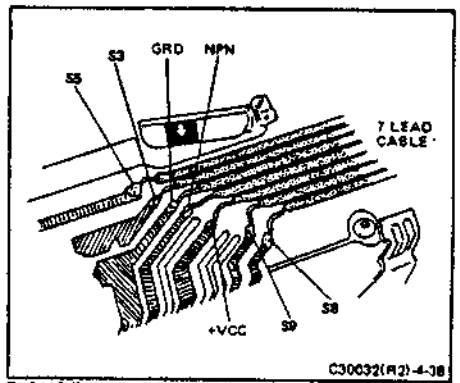


FIGURE 4-38 CONNECTING 7 LEAD SHUTTER CABLE TO 10 PAD FLEX CIRCUIT

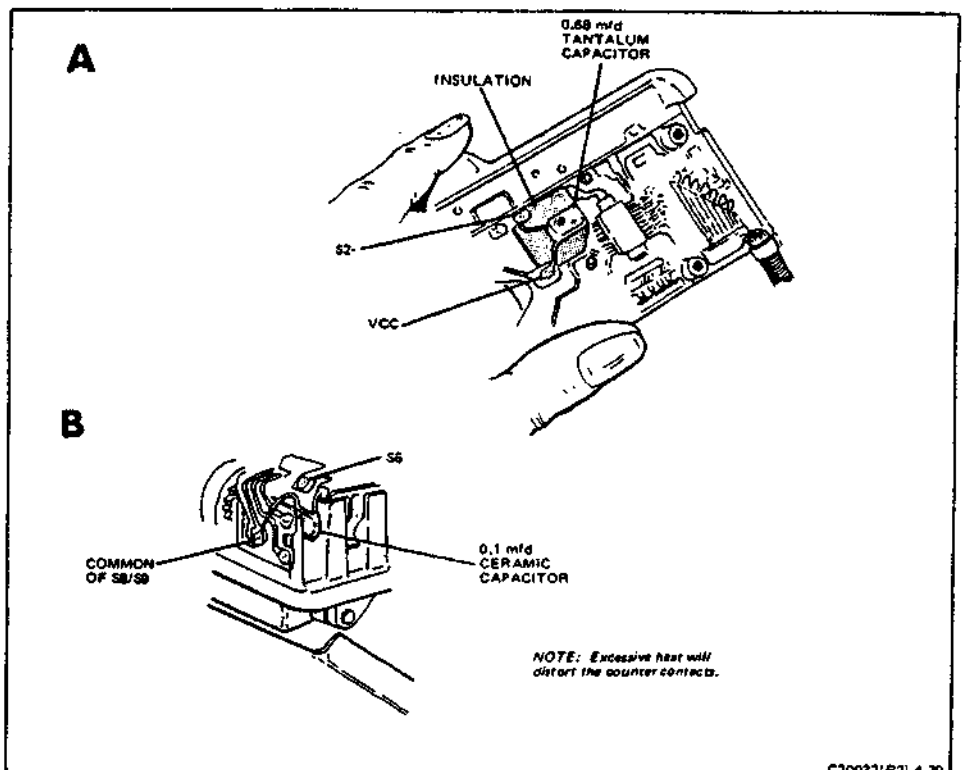


FIGURE 4-39 NOISE SUPPRESSION MODIFICATION

To install the capacitors:

(a) To prevent shorting, place a small piece of insulating tape or .001 mylar on the substrate, in the area indicated by the black shading in Figure 4-39"A".

(b) Solder the tantalum capacitor legs to the VCC terminal and to ground.

(c) Bend back the capacitor so it lies flat on the tape or mylar.

(d) Cover the capacitor bead with tape.

(e) Be sure the capacitor is not damaged when the shutter is installed on the hinge bracket.

(f) If the mid-cycle shutdown still persists, add a second ceramic capacitor between S6 and the common of S8/S9 on the counter (Figure 4-39"B").

G. SHUTTER COMPONENTS

To repair or replace shutter components, it is necessary to remove the shutter from the camera and then disassemble it to the point where the repair can be made. This paragraph instructs you how to disassemble the shutter, reassemble it and then explains the various repairs/adjustments which may be performed. When making the repair or adjustment, disassemble the unit only to the point necessary to gain access to the affected components. (If possible, avoid unsoldering the cable leads to the flex circuit.) Refer to the Configuration Control drawings to identify all parts mentioned in this paragraph.

1. Shutter Housing

Removal

a. Erect the camera to picture-taking configuration.

b. Open and remove the front cover.

c. Remove the four screws which secure the shutter to the mounting bracket.

Caution: When the shutter retaining screws are removed, the shutter will remain attached to the camera by the ribbon cable. Use care to avoid damage to the cable.

d. Remove the two retaining screws from the upper corners at the rear of the shutter.

NOTE: Plastic baseplate shutters do not require screws to hold the front housing. On these shutters simply snap the housing off the shutter. Plastic baseplate assemblies can be identified by a circle around the mold marks.

e. Make sure the lens is set at infinity (rotated clockwise to its stop).

f. Remove the shutter front housing from the casting.

g. To provide a safe, steady work surface, place the shutter casting on the hinge bracket and install one of the retaining screws to hold it in place. At this point, you may start to remove the internal shutter components.

Installation

a. Rotate the lens to its clockwise (infinity) stop (if it was moved during repair).

b. Place the housing in position on the shutter so that the focus and trim wheels protrude through the correct slots.

c. Snap the bottom of the housing over the casting.

d. Install and tighten the two shutter front housing screws. (Aluminum baseplate shutters only.)

e. Position the shutter on the hinge bracket by aligning the locating pins (see Figure 4-40).

f. Install and tighten the four retaining screws.

g. Complete camera reassembly.

h. Perform lens collimation.

i. Perform complete comprehensive test series.

2. Shutter Front Housing Components

Removal

a. Remove the shutter from the camera and the housing from the shutter.

b. Remove the lens bezel by pressing the edge of the bezel from inside the housing.

c. If the photocell bezel and filter are assembled, insert a finger nail under the bezel and pull it free of the housing. Otherwise, push the assembly from the rear to snap it out of the housing.

Installation

a. Install the lens bezel:

(1) The bezel has a large rectangular cutout in its rim. When installing the bezel, the cutout should be approximately 8 o'clock when viewed from the front of the housing.

(2) At 6 o'clock, the bezel has a tiny locking tab. Locate this tab to align with the notch on the inside edge of the housing.

(3) Press the bezel into place.

(4) Rotate the focus wheel and check for binding.

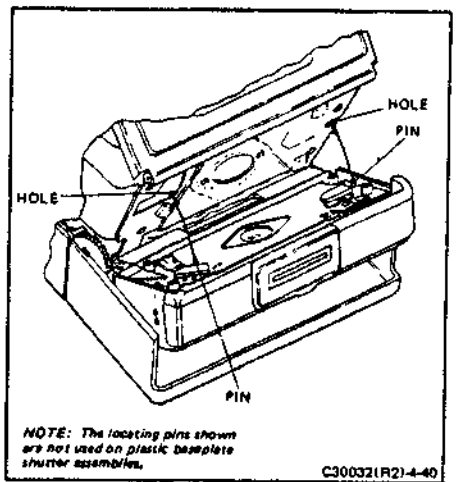


FIGURE 4-40 SHUTTER ASSEMBLY LOCATING PINS

b. Install the photocell bezel assembly:

(1) Align the three tabs with the three cutouts in the housing.

(2) Press the bezel into place.

c. Install the housing on the shutter and the shutter assembly on the camera. Complete camera reassembly.

3. Trim Assembly/Focus Wheel

Removal

a. Remove the shutter housing and set the casting on the hinge bracket as instructed.

b. Remove the two screws which secure the trim assembly to the casting.

c. Carefully lift off the trim assembly.

d. Using Special Tool #11655, remove the focus wheel retainer screw.

NOTE: Newer shutters have a spring-loaded idler gear which affects the focus wheel hardware. Be sure to replace the hardware with the same type as that removed.

e. Remove the focus wheel.

f. Remove the E-ring which holds the trim link at its pivot point. (On some shutters a screw is used to secure the trim link.) Remove the trim link.

Installation

a. Position the trim link in the shutter and secure it at its pivot point using either the screw or the E-ring.

b. Be certain that the lens mount is still at its infinity (full clockwise) setting. Then, rotate it counterclockwise about three teeth.

c. Examine the underside of the focus wheel. Note two rectangular depressions and a spiral groove (Figure 4-41). One depression is positioned closer to the end of the groove. When the focus wheel is positioned on the follower, the positive stop pin must engage the rectangular depression farthest from the groove. The pin of the cam follower must engage the spiral groove. Install the wheel so these conditions are satisfied.

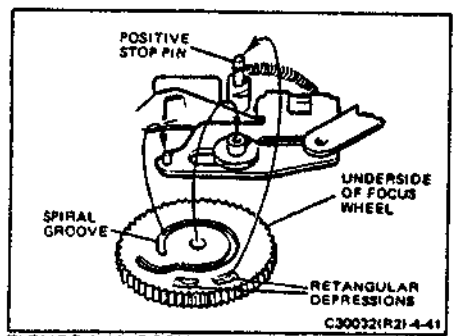


FIGURE 4-41 FOCUS WHEEL CONFIGURATION

d. Install the focus wheel retaining screw using Special Tool #11655.

e. Run the focus wheel through its full travel to be certain that it is properly installed.

f. With the trim wheel set at mid-point, install the trim assembly. Be sure that the pin on the trim assembly engages the slot on the trim link and the locating studs enter the locating holes in the casting.

g. Secure the trim assembly using the two retaining screws.

h. Check the operation of the trim assembly.

i. If the trim was changed, check the front housing to be sure of compatibility. (See "Repairs/Adjustments" below.)

j. Reassemble the shutter and reinstall it on the camera.

Repairs/Adjustments

a. Photocell/Trim Assembly Compatibility

On later cameras, the photocell lens has been changed from a "bullet" to a "lollypop" shape (Figure 4-42) and the opening in the trim from a hole to an arrowhead. The newer design results in better exposure control on back light and side light scenes.

If it is necessary to replace a trim assembly, follow these general rules: Replace a "one hole" trim with a "one hole" trim. Replace an "arrowhead" trim with an "arrowhead" trim. Consult the chart immediately below to determine the interchangeability of trim assemblies to photocell lenses ("Trim Assembly/Photocell Lens Interchangeability").

Caution: Because of critical positioning problems, the photocell lens cannot be replaced. If it is defective, replace the shutter assembly.

TRIM ASSEMBLY/PHOTOCELL LENS INTERCHANGEABILITY

	FAIRCHILD SHUTTERS		TEXAS INSTRUMENT SHUTTERS	
	"Lollypop" Lens	"Bullet" Lens	"Lollypop" Lens	"Bullet" Lens
"One Hole" Trim	No	Yes*	Yes*	Yes*
"Arrowhead" Trim	Yes*	No	Yes*	Yes*

*Upon reassembling shutter to camera, collimate and perform comprehensive tester checks.

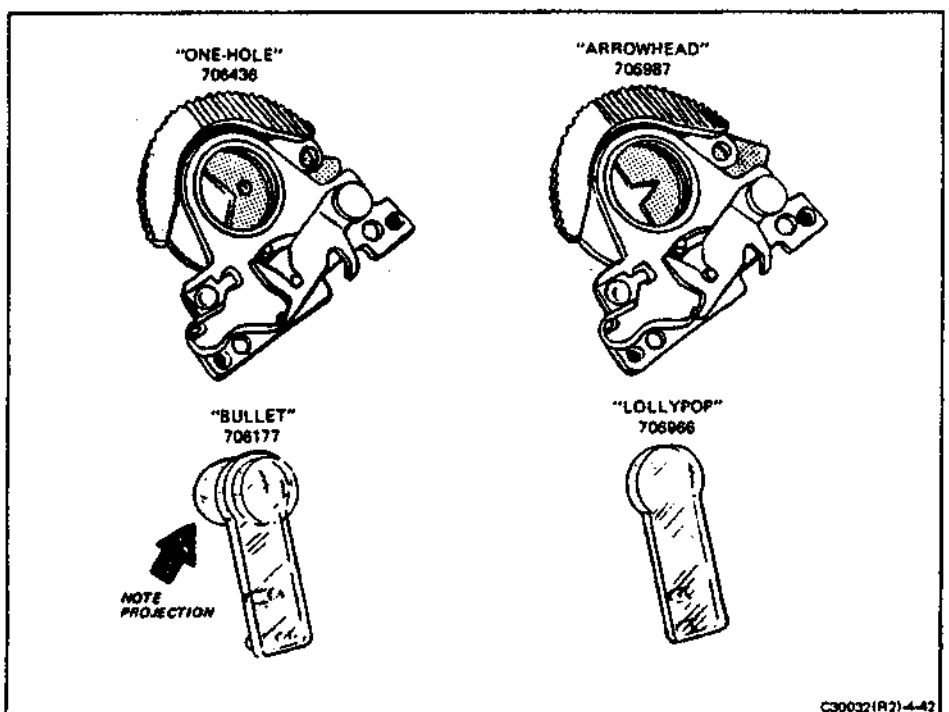


FIGURE 4-42 COMPARISON OF TRIM/PHOTOCELL LENS ASSEMBLIES

b. Photocell Filters

The photocell filter (also called window assembly) is located on the shutter housing. It acts together with the trim assembly and photocell lens to control the shutter exposure time.

If the camera is overexposing, the fault may be corrected by changing the photocell filter, correcting the shutter tracking or both. It is first necessary to identify the possible correction. Do this as follows:

(1) Remove the photocell bezel and filter from the housing.

(2) Install the camera on the Comprehensive Tester and perform the ambient mode exposure test.

(3) If the reading obtained without the filter is greater than the specification value, a filter change will not correct the problem. In this instance, one of three things must be done:

- If a Fairchild shutter, change the value of the calibration resistor.
- Change the electronic control module.
- Change the shutter.

(4) If the exposure reading is between +0.2 and −0.1, the camera will produce correct exposures with no photocell filter. However, a filter must always be in place since the photocell opening must not be left unprotected. Install the lightest (least density) and retest the camera. If the exposure readings are still between +0.2 and −0.1, the over-exposure problem has been resolved. See "Photocell Filter Ranges" Table for the available filters.

(5) If the exposure reading obtained in step (4) was less than −0.1, remove the camera from the tester and install a filter with a stop value most nearly equal to the meter reading. Retest the camera: An exposure meter reading of zero indicates a perfect exposure. See the table below for the range of filter values.

PHOTOCELL FILTER RANGES

NOTE: New, higher density filters are available to correct "underexposure" difficulties in "P" shutters. The table below lists all groups with density ranges. The last four groups (14-17) are the new T.I. Photo II filters.

Lower Density	Group	Median P Stop	Minimum F Stop	to	Maximum F Stop
	1	.13	.01		.16
	2	.20	.17		.23
	3	.27	.24		.30
	4	.34	.31		.37
	5	.41	.38		.44
	6	.48	.45		.51
	7	.55	.52		.58
	8	.62	.59		.65
	9	.69	.66		.72
	10	.76	.73		.69
	11	.83	.80		.86
	12	.90	.87		.93
	13	.97	.94		1.00
	14	1.04	1.01		1.07
	15	1.13	1.08		1.16
	16	1.20	1.17		1.23
Higher Density	17	1.27	1.24		1.30

706294	Clear-grey-black	Texas Instrument Shutters
706694	Frosted	Fairchild Shutters
706857	Clear-Blue/green	Both T.I. and Fairchild

(6) If the camera malfunction is under exposure, all of the procedures in this section can be applied to located the fault.

(7) If the camera produces an extremely long exposure and has passed initial tests, visually examine the photocell optical path. If any obstruction is found, clean the optical path with lens cleaner and retest.

(8) If the photocell optical path is clear and the camera still produces an extremely long exposure, the ECM is faulty. Replace the ECM or the shutter assembly.

4. Focus Wheel/Cam Follower Assembly Including Positive Stop Pin

Removal

a. Remove the shutter housing and set the casting on the hinge bracket as previously instructed.

b. Using Special Tool #11655, remove the focus wheel retainer.

NOTE: Newer shutters have a spring-loaded idler gear which affects the focus wheel hardware. Be sure to replace hardware with the same type as that removed.

c. Remove the focus wheel.

d. Remove the cam follower retainer. Unhook the follow focus extension spring and remove the cam follower assembly. Also, remove the positive stop pin.

e. Using tweezers, reach down into the stop-pin cavity and remove the compression spring.

Installation

a. The cam follower assembly includes the interceptor which must reach under the pull-down bar of solenoid no. 2. Use tweezers and slide the interceptor under the bar. At the same time, position the cam follower so that its wider slot is centered over the threaded hole in the mounting post (see Figure 4-43). Secure it with the cam follower retainer.

b. Engage the trim link pin with the narrower slot in the cam follower.

c. Install the positive stop pin:

(1) Install the compression spring into the positive-stop-spring socket in the shutter casting.

(2) Insert the stop pin on top of the compression spring.

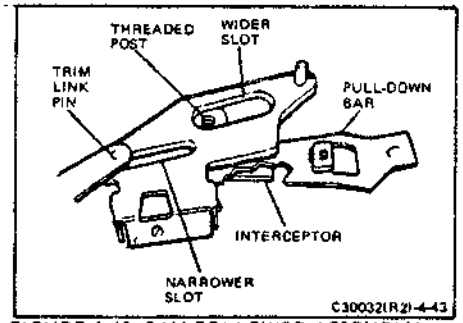


FIGURE 4-43 CAM FOLLOWER ASSEMBLY

(3) Identify the follow focus extension spring which fits between the cam follower and positive stop pin.

(4) Hook one end of the spring into the hole adjacent to the adjusting screw in the top of the cam follower assembly.

(5) Hook the other end of the spring onto the positive stop pin.

d. Install the focus wheel and wheel retainer screw using Special Tool #11655.

e. Adjust the cam follower assembly:

(1) The adjustment requires that power be applied to the shutter. Install the special housing containing the hole for cam-follower adjustment.

(2) Perform the electrical test as described in "Follow Focus Test" in Section III.

(3) Using a narrow-blade jeweler's screwdriver through the adjusting hole, rotate the cam-follower adjusting screw as necessary to produce the proper meter reading.

Repairs/Adjustments

a. Focus Wheel Components

The focus wheel, focus wheel pivot, cam follower assembly retainer, and focus wheel retainer have been changed on newer cameras as follows:

Older Cameras	Newer Cameras
Focus wheel retainer "E" ring #706629.	
Hex screw 0-80 thread #706065 (nickle-plated finish)	Hex screw 0-80 thread: Part #726019 (brass flash finish)
Focus wheel – .093 center hole; part #706329	.125 center hole part #706988
Cam follower assembly retainer metal "E" ring #706628	Plastic snap ring part #706697
Focus wheel pivot with provisions for "E" ring; part #706929	Pivot with 0.80 tapped hole for hex screw: & .005 groove for plastic retainer part #706699

See Figure 4-44 for identification of these parts.

The new focus wheel and retainer are not interchangeable with focus wheel part #706329 PP11 and retainer part #706065 used on shutters configuration F through M or any other type. Although the old focus wheel may fit, it will not function properly. Do not interchange these parts.

If a shutter with the new spring loaded idler gear and plastic snap ring is received for repair, confirm that the focus wheel retainer part #726019 (identified by brass flash finish) is used. If not, install the new retainer on the focus wheel.

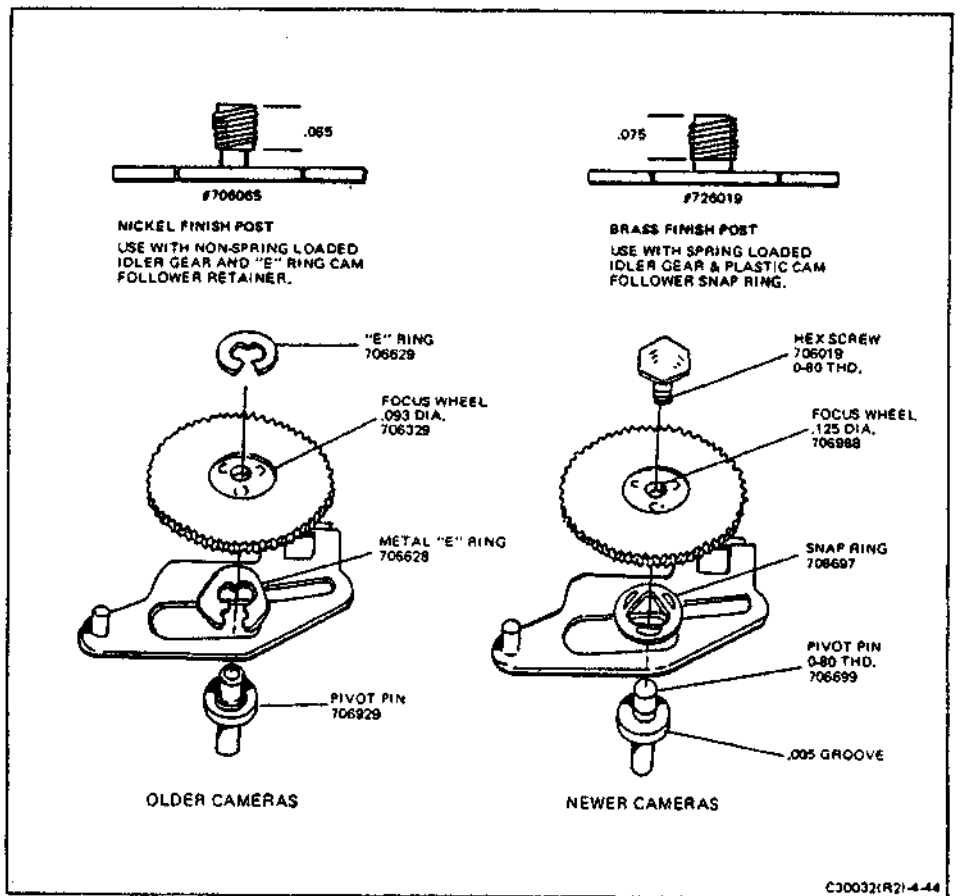


FIGURE 4-44 COMPARISON OF CAM FOLLOWER COMPONENTS

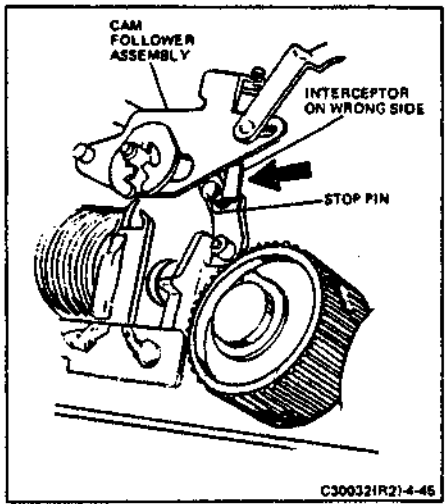


FIGURE 4-45 INTERCEPTOR ON WRONG SIDE OF STOP PIN

b. Interceptor on Wrong Side of Stop Pin (Older Cameras)

This condition is identified by the inability of the lens to go to its infinity stop and by "spongy" travel near the end of the lens travel. Also, in some cases, shutter blade hang up with high amp draw may occur. Figure 4-45 shows what the shutter parts look like when the interceptor is mis-located.

To correct this problem, do the following:

(1) Set lens to infinity, set trim wheel to full light, then remove the focus wheel, and release initial hang-up with a dental pick.

(2) Mix some "Devcon" 5-minute epoxy.

(3) With a jeweler's screwdriver, insert the blade behind the Sol. #1 plunger, and push inward, and hold this position (see Figure 4-46).

(4) Put a pencil point amount of epoxy on the follow focus stop pin head.

Caution: Be careful not to drop any epoxy into the shutter.

(5) With a tweezer, put the new cap (#0, S.S. flat washer) on the follow focus stop pin. It is important that the new cap be put on in the same position as shown in Figure 4-46. The edge of the new cap must line up with the edge of follow focus stop pin.

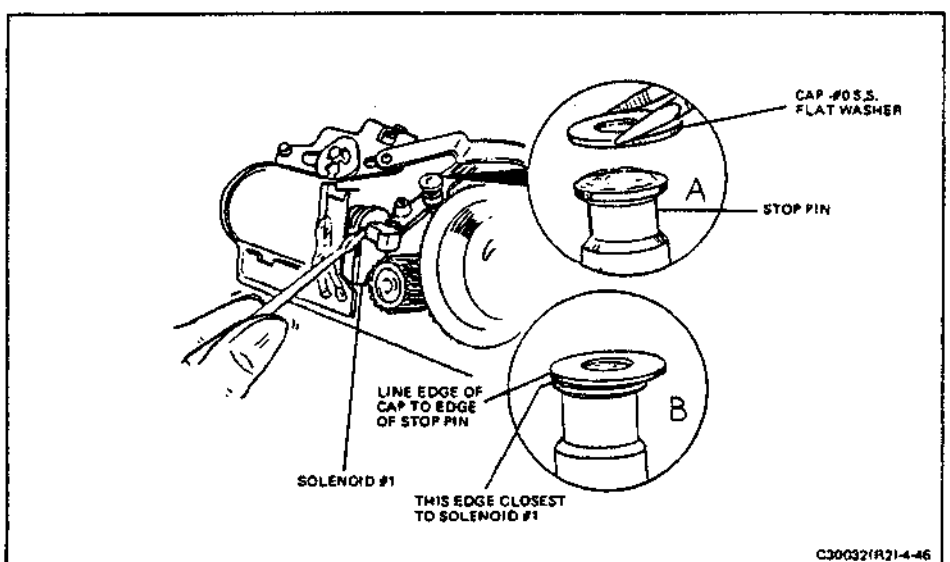


FIGURE 4-46 INSTALLING CAP ON FOLLOW FOCUS STOP PIN

(6) Allow enough time for the epoxy to set (10 minutes).

(7) Assemble the focus wheel. Simulate intercept, by using a flash simulator board, a film pack simulator #11774 (or empty film pack), a remote shutter release cable #112, and an S7 actuator. Cycle the camera at least 10 times and, visually check to see the aperture opening in the lens (small for close focus, and large for infinity). Also, visually check to see if there is any intercept hang up on the wrong side of the follow focus pin. Check the clearance between the intercept arm and the top of the new cap. (There should be enough space to pass a dental pick tip through the gap.)

(8) Reassemble the shutter and install the shutter on the camera.

(9) Check camera on Comprehensive Tester (A or B) at flash exposure, (10.4" and 8' setting). Adjust camera if out of specification at these settings.

5. Idler Gear

The idler gear connects the focus wheel to the lens. Figure 4-47 shows the location of the gear in the shutter.

Removal

a. Using Truarc pliers, remove the idler gear retaining ring.

b. Slide the idler gear off its post. (Try to maintain the position of the focus wheel and lens assembly to prevent the loss of lens collimation.)

Installation

a. Place the idler gear over the idler gear post.

b. Install the retaining ring to secure the gear on the post.

c. Recollimate the camera.

Repairs/Adjustments

"Tight" focus mechanism movement may be traced to binding of the idler gear. If analysis of this complaint determines that the idler gear is the cause of the "tight" movement, replace the gear with a new repair idler gear:

Early Cameras

Early cameras may be modified by changing the idler gear with a repair idler gear, part number 700905.

Newer Cameras

Newer cameras employ a spring-loaded idler gear assembly which facilitates collimation (see Section 3). If the idler gear on these cameras is binding, replace it with a repair idler gear, part number 700907.

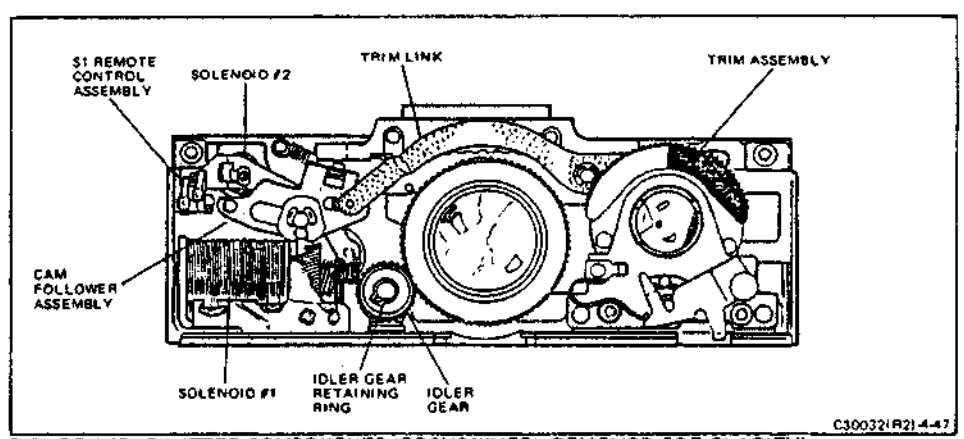


FIGURE 4-47 SHUTTER COMPONENTS (FOCUS WHEEL REMOVED FOR CLARITY)

After installing a repair idler gear, check the shutter for backlash (see Figure 4-48). Try to rotate the focus wheel while holding the lens steady, preventing it from turning. Using the trim link as a marker, rock the focus wheel through its total backlash while holding the lens. The total travel cannot exceed the width of 1/2 tooth. If focus wheel backlash exceeds 1/2 tooth, the shutter assembly must be replaced.

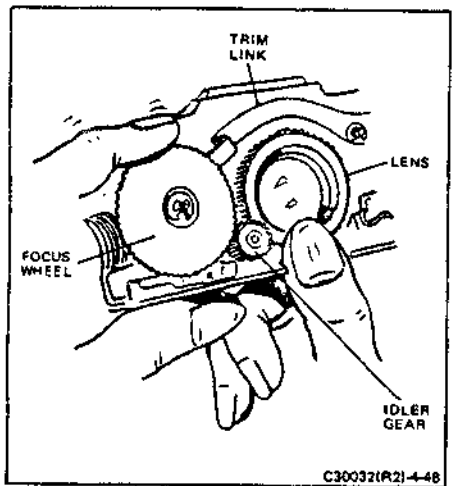


FIGURE 4-48 TESTING FOR IDLER WHEEL BACKLASH

6. S1 Remote Control Assembly/Solenoid #2

The S1 remote control assembly (refer to Figure 4-47) provides the contacts for a remote shutter cable. If it is damaged, replace it as follows:

Removal

a. Remove the focus wheel and cam follower assembly as instructed.

b. Unsolder the S1 and Solenoid #2 contacts from the substrate (Figure 4-49).

c. Using Special Tool #11661 (miniature off-set open-end wrench), remove the solenoid retaining nut from under the substrate. Use care to avoid damage to the substrate. As the nut is loosened, pull up on the solenoid to remove it from the shutter.

d. Remove the S1 block retaining screw.

Installation

a. Position the S1 block on the casting and secure it with the retaining screw.

b. Install solenoid #2. Note that there are two insulated connecting tabs and a short locating stud in addition to the threaded mounting stud. Position the solenoid carefully so the locating stud bottoms in its hole. Use Tool #11661 to install and tighten the mounting nut.

c. Carefully dress the contacts over their pads on the substrate (refer again to Figure 4-49) and solder the solenoid #2 and S1 contacts. (When soldering the S1 contacts use care to prevent distorting the spring-action of the contacts. First, insure a good connection before applying solder. Then, do not hold the contacts down with the soldering iron since they will spring up as soon as pressure is removed and will likely break the solder connection.)

d. Install the cam follower assembly and focus wheel as previously instructed.

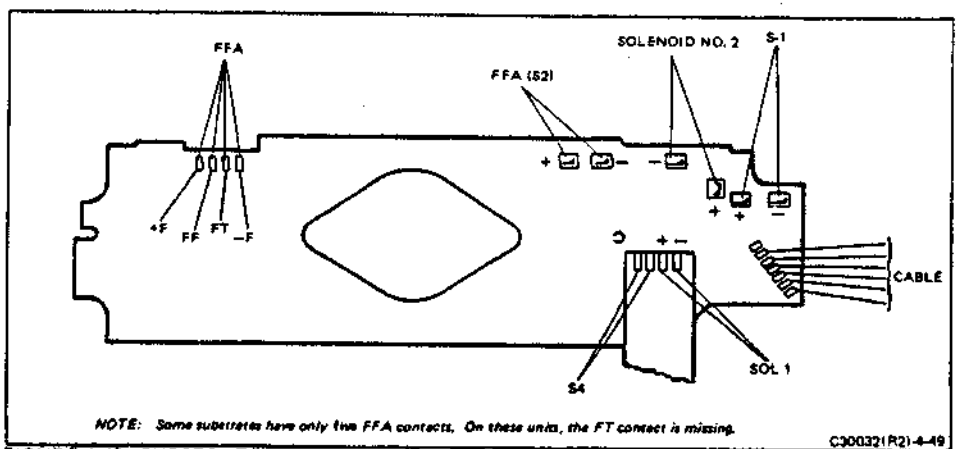


FIGURE 4-49 SUBSTRATE SOLDER CONNECTIONS

Repairs/Adjustments

The following procedure should be used to check the stroke of solenoid #2. Refer to Figure 4-50 when performing this procedure.

a. Set lens at infinity, and trim to full light.

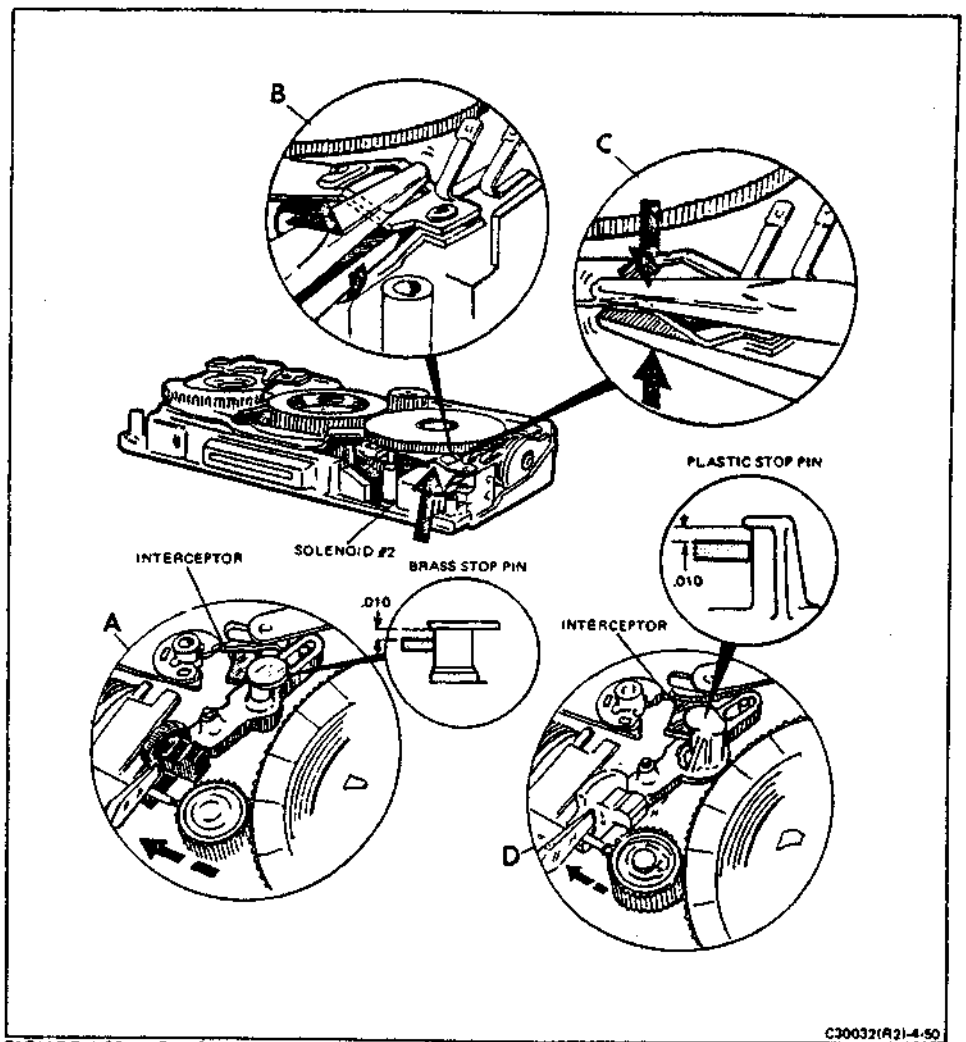


FIGURE 4-50 ADJUSTING STROKE OF SOLENOID #2

b. Remove shutter from camera and remove the front housing as previously instructed.

c. Using a jeweler's screwdriver, depress solenoid #1 plunger until it is seated (blades closed).

d. Gently hold the shutter blades closed at the edge of the casting – near trim assembly – the jeweler's screwdriver can now be removed from solenoid #1 plunger.

Caution: To avoid finger-prints on blades, finger protectors or gloves should be used.

e. Using jeweler's screwdriver, depress solenoid #2 plunger until it is fully seated. Do not allow the screwdriver to touch the pull-down bar.

f. Release blades.

g. Inspect for correct intercept as shown in insets A and D of Figure 4-50. (The interceptor should not touch solenoid #2 frame.)

h. If the intercept is out of spec., remove the focus wheel and adjust the solenoid #2 adjusting screw as follows:

(1) Break loctite bond on solenoid #2 screw using jeweler's screwdriver.

(aa) *For High Intercept:* Turn adjusting screw counterclockwise, in increments of 1/4 turn, with jeweler's screwdriver. Retest as above after each 1/4 turn.

(bb) *For Low Intercept:* Turn adjusting screw clockwise in increments of 1/4 turn with jeweler's screwdriver. Retest after each 1/4 turn.

(2) If the loctite bond cannot be broken, bend the pull-down bar with a needle-nose pliers (at the point shown in the illustration) as follows:

(aa) *For High Intercept:* Bend bar upwards (increase angle) at the point shown in inset "C" and retest.

(bb) *For Low Intercept:* Decrease angle slightly by squeezing pull-down bar as shown in inset "B" and retest.

(i) After making the stroke adjustment, recheck at infinity and 10.4" for correct intercept, and to insure that the interceptor doesn't hit solenoid #2 frame.

NOTE: If the loctite bond on the adjusting screw was broken, reseal the screw with loctite before reassembling the camera.

7. Flash Fire Assembly (FFA)

The flash fire assembly contains the flashbar socket and associated electronics. (If the camera has an old T.I. shutter with a ceramic substrate, do not attempt to replace the FFA. The entire shutter should be replaced.)

Removal

a. Remove the trim link as instructed earlier.

b. At the substrate, identify the six FFA contacts (see Figure 4-49). Unsolder the contacts as follows:

(1) Apply heat to one contact at a time.

(2) As heat is applied, use an Xacto knife to raise each connector. Use extreme care to prevent damaging the substrate.

c. After unsoldering all six FFA contacts, press out the two rivets securing the socket to the casting (Figure 4-51). Carefully lift the socket assembly free of the casting, avoiding damage to the contacts.

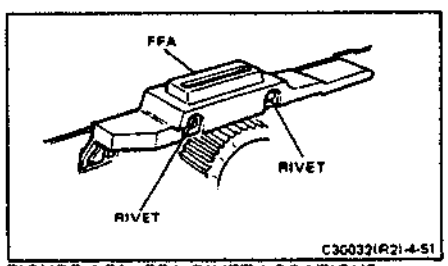


FIGURE 4-51 FFA RIVET LOCATIONS

Installation

a. Very carefully, position the flash socket onto the casting, maneuvering the contacts to the appropriate pads on the substrate.

b. When the socket is properly positioned, secure it to the casting with two rivets using Special Tool #11735.

c. Using tweezers, bend down one of the contacts in the four contact group over its corresponding pad on the substrate. (If needed, the contact may be cut to fit properly on the pad, thus eliminating the possibility of a short.)

d. Repeat the previous step for the remainder of the FFA contacts. (Note that in the two contact group, the contacts must be bent upward onto the pads.)

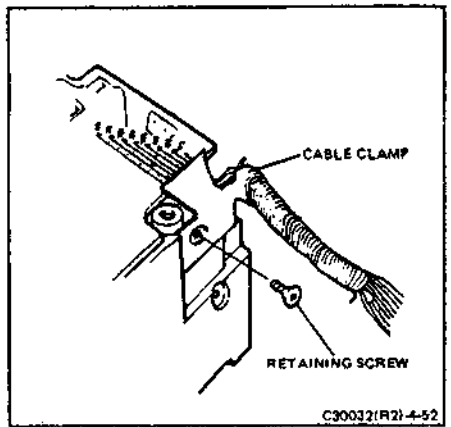


FIGURE 4-52 MULTI-WIRE CABLE CLAMP

e. Carefully examine the soldering to be certain there are no cold solders, bridges, or icicles.

f. Install the trim link.

8. Substrate

If troubleshooting with the Fault Analysis Charts in Section 3 confirms that the shutter substrate must be replaced, follow the procedure below. (This procedure applies only to "P" configuration or later shutters.)

Removal

a. Remove the shutter from the camera and the front housing from the shutter as previously instructed.

b. Remove the cable clamp retaining screw (Figure 4-52).

c. Set the shutter assembly onto holding fixture #CR11892 as shown in Figure 4-53.

d. Using a miniature soldering iron (e.g., Weller W-TCP-L or equivalent) heat each of the connections on the substrate (refer again to Figure 4-49). With the point of an X-acto knife, gently lift the terminal up and away from the substrate. Repeat this for each of the connections on the substrate.

Caution: Do not attempt to lift the terminals

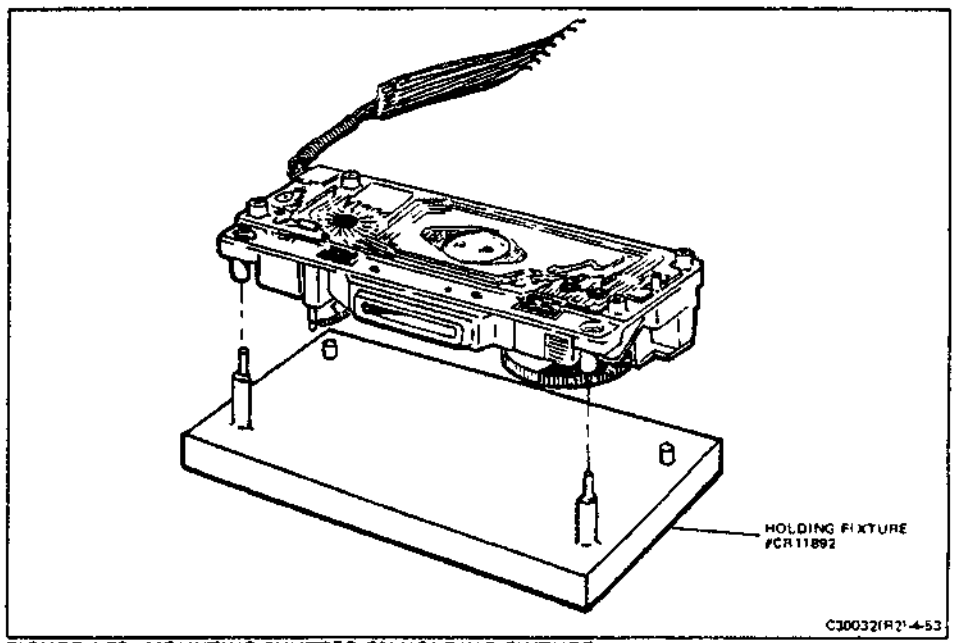


FIGURE 4-53 MOUNTING SHUTTER ON HOLDING FIXTURE

until the solder starts to flow. The FFA terminals and solenoid #1 flex in particular are very fragile. Use extra care when handling these contacts.

e. Once all the contacts are unsoldered, lift the substrate with cable off the shutter.

Installation

Caution: Check all terminals on the new substrate for any solder residue that may cause a short to the casting. Do not bend the substrate since internal damage to the integrated circuits could occur.

a. Position the substrate over the locating pins on the casting and carefully lower the substrate insuring that all leads come through the appropriate openings on the substrate. Make certain that the substrate lies flat on the casting.

b. Install the retaining screw to secure the cable clamp to the casting.

c. Using tweezers, very carefully bend each lead over its solder pad on the substrate.

d. Solder each lead one at a time, being careful not to use too much solder.

NOTE: When replacing a Fairchild substrate, clip off the FT terminal from the socket.

e. Check each of the solder leads visually. Figure 4-54 shows examples of good and bad solder joints. Be certain that the solder joints conform to the good examples. (A usually accurate indication of an acceptable connection is a neat, shiny solder joint.)

f. Reassemble the shutter. Before installing it on the camera, check shutter operation on the shutter tester.

g. Install the shutter on the camera. Check camera operation on the Comprehensive Tester.

9. Separating Front and Rear Lens

If dirt should accumulate between the front and rear lens elements, proceed as follows:

a. Set the lens at the infinity position.

b. Use a grease pencil and mark the rim of the lens at the four o'clock position. This mark will be needed when the lens is reinstalled.

c. Rotate the focus wheel to set the lens at 10.4".

d. Use Bristol screwdriver no. 11753. On the underside of the shutter housing, loosen the idler gear screw. On newer cameras the idler gear may be disengaged simply by pressing it down with tool #11939.

e. While the idler gear is disengaged, unscrew the front lens element and clean the dirt. Continue below:

10. Cleaning/Lubricating Lens Barrel Threads

A common malfunction which causes sticking or binding of the focus wheel can be traced to the threads of the lens barrel. When it is known that the focus wheel is not at fault, clean and lubricate the threads as follows:

a. Remove the front lens assembly (paragraph 9 above).

b. With a Q-tip, clean the threads of the barrel.

c. Apply thread lubricant with a small brush similar to a woman's finger nail polish brush.

d. Use a hand held hair dryer with medium heat and thoroughly dry the lubricant.

e. Clean the lens inner surface with a Q-tip.

f. Reinstall the front lens assembly. Line up the previously grease-marked lines when starting the lens into the rear element. After the lens is started, turn it all the way to the infinity setting and check that the grease mark on the lens rim is at the four o'clock position.

g. After reassembling the camera, perform the collimation procedure prescribed in Section 3.

H. SHUTTER HINGE BRACKET

Although the shutter mounting hinge bracket is not an externally mounted component, it is subject to damage from improper handling of the camera. If force is used to close the camera without first releasing the erecting link, the hinge bracket (as well as the erecting link) will be sufficiently damaged to necessitate replacement. The damage will be evidenced by failure of the camera to close and latch in the proper manner. The hinge bracket is replaced in the following manner:

Removal

1. Erect the camera to picture-taking configuration.

2. Open and remove the front cover.

NOTE: On early cameras, the shutter hinge bracket is held to the bottom plate with hinge pins. Release the bracket as directed in step 3 below (Figure 4-55). On later cameras, the bracket is riveted in place. Remove the rivets using Special Tool #11877.

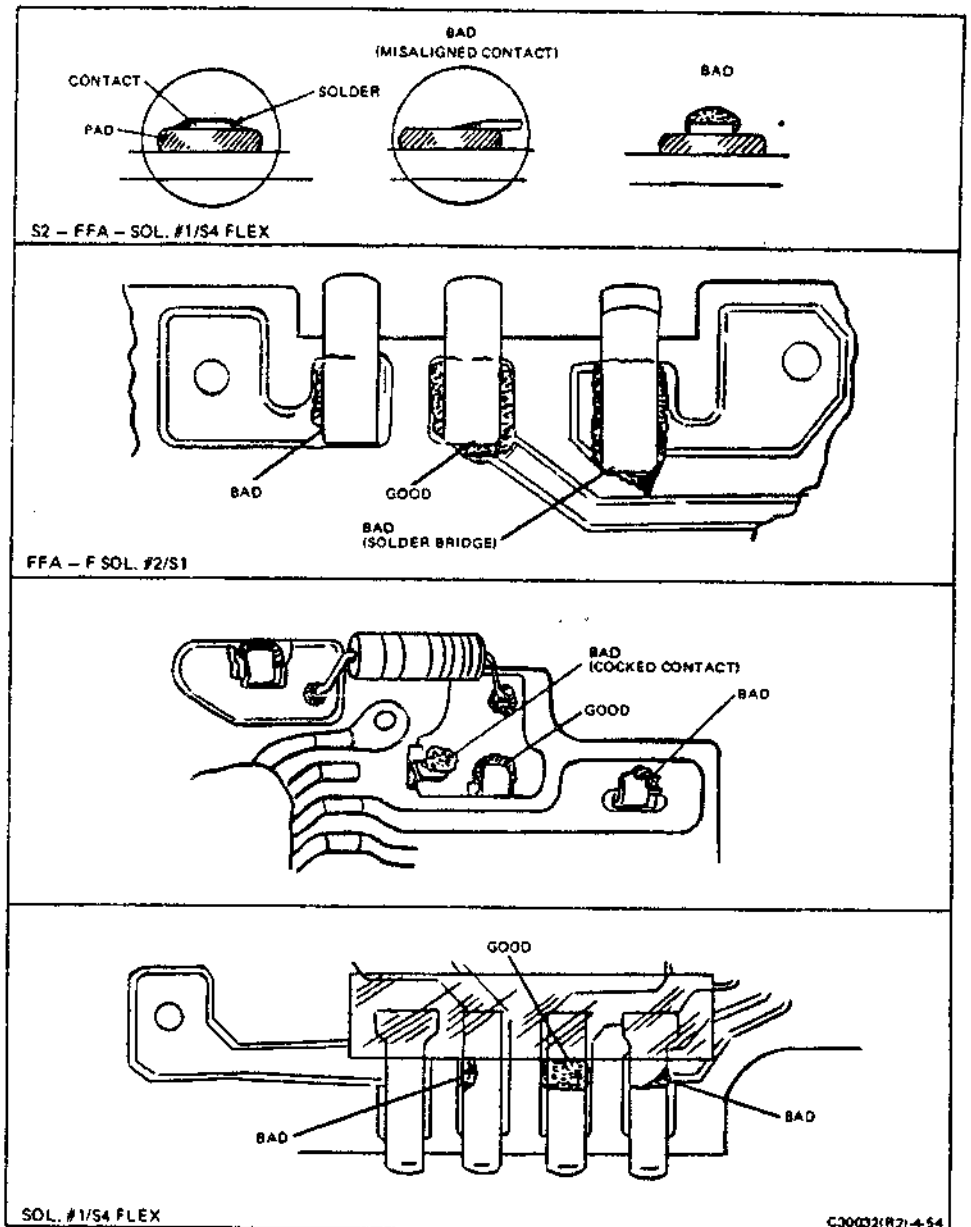


FIGURE 4-54 ACCEPTABLE/NON-ACCEPTABLE SOLDER JOINTS

3. Using the blade of a jeweler's screwdriver, spring the shutter hinge bracket on each side just enough to release the pins. See Figure 4-55. This will release the shutter hinge bracket from the bottom plate.

Caution: With the retaining screws removed, the shutter is still attached to the camera flex circuit by the ribbon cable. Handle the camera and shutter with care to prevent damage to the cable.

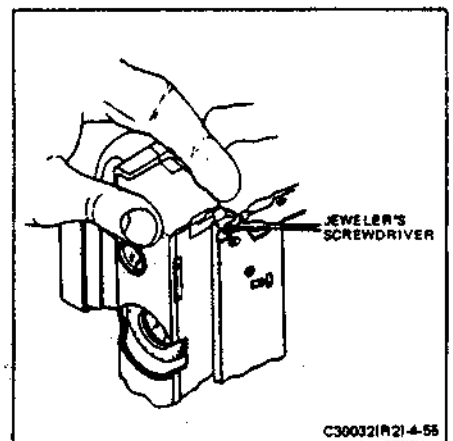


FIGURE 4-55 RELEASING SHUTTER MOUNT HINGE BRACKETS

4. Hold the shutter in place on the hinge bracket and remove the four hinge-bracket-to-shutter-retaining screws.
5. Remove the two hinge-to-boot-retainer screws located adjacent to the round lens opening in the shutter hinge-bracket. Newer cameras have rivets instead of screws.
6. Using Special Tool #11654, remove the shutter-hinge-bracket-to-short-cover hinge pins. See Figure 4-56. The hinge bracket may now be removed.

Installation

NOTE: If the bracket was originally riveted, replace the rivets. If bracket looseness has been reported, replace the hinge pins with rivets (see "Repairs/Adjustments", paragraph 2). Otherwise, continue with the procedure below.

1. To install the replacement shutter mounting

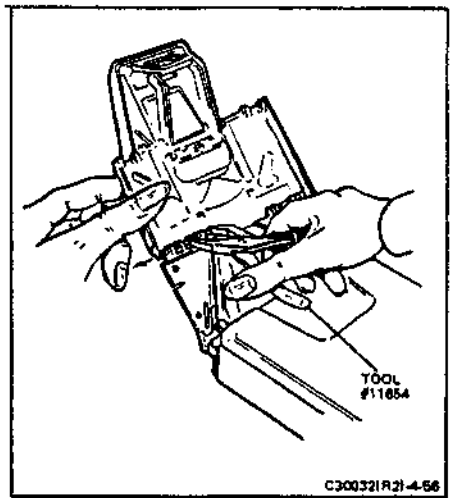


FIGURE 4-56 REMOVING SHUTTER BRACKET/ SHORT COVER HINGE PINS

hinge bracket, place the bracket into position, align the short cover and hinge bracket hinges, and insert the short cover hinge pins.

2. Tap the hinge pins into place so that the outer ends of the pins are flush with the outer hinge surfaces.
3. Install and tighten the two shutter-hinge-bracket-to-boot retaining screws.
4. Using a jeweler's screwdriver, carefully pry each of the two hinges at the lower corners of the bracket just enough to spring the pivot pins into their sockets.
5. Swing the shutter into position on the hinge bracket.
6. Install and tighten the four shutter retaining screws.
7. Close the front cover and check the camera.

Repairs/Adjustments

1. Shutter Installation

Some Fairchild printed circuit substrates are not insulated and may short out on the original shutter hinge bracket, part no. 705297. To prevent this, remove the 3 insulating pads on the bracket and replace them with a 2 piece insulation, numbers 705894 and 705892 as shown in Figure 4-57. Or replace the entire shutter bracket with the new type no. 705893.

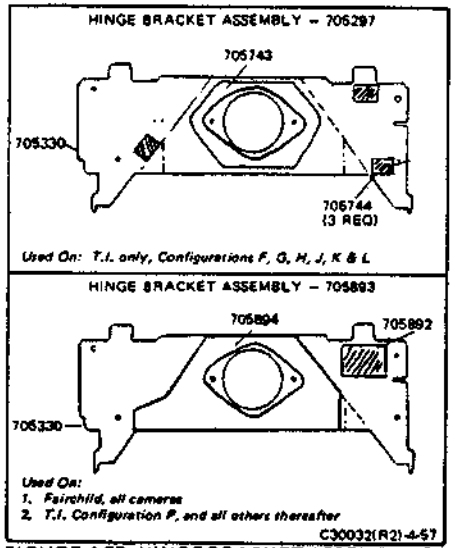


FIGURE 4-57 HINGE BRACKET ASSEMBLIES

2. Bracket Looseness

This procedure is to be used when a camera is received with a complaint that the shutter bracket easily becomes disconnected from the bottom plate. This problem is resolved by replacing the shutter hinge pins with rivets. (Later cameras already have rivets in place of the hinge pins. If one of these later cameras is received with this complaint, it undoubtedly results from a broken rivet. Remove the broken rivet using Special Tool #11877 and replace it with rivet #705639.) To change from hinge pins to rivets, complete the procedure which follows:

a. Open the camera and erect it to picture-taking configuration.
b. Remove the front cover from the camera.
c. Release the shutter hinge bracket from the bottom plate by springing the bracket free using a jeweler's screwdriver as shown in Figure 4-55.
d. Punch out the hinge pins from the bracket using Special Tool #11877. Examine the bracket for distortion. If the distortion is excessive, replace the bracket.
e. With a #1 center drill held in a hand pin vise, cut away a clearance area on the inner frame to provide enough room for the rivet installation (see Figure 4-58"A"). Use extra care when starting to cut into the plastic since excess force could break the bond between the inner frame and the bottom plate assembly. Start cutting with the tool held at an angle as shown in Figure 4-58"A". When the cutout is well started, lower the angle of the drill to complete cutting the inner frame. When done it should look like the inset in Figure 4-58"B".)

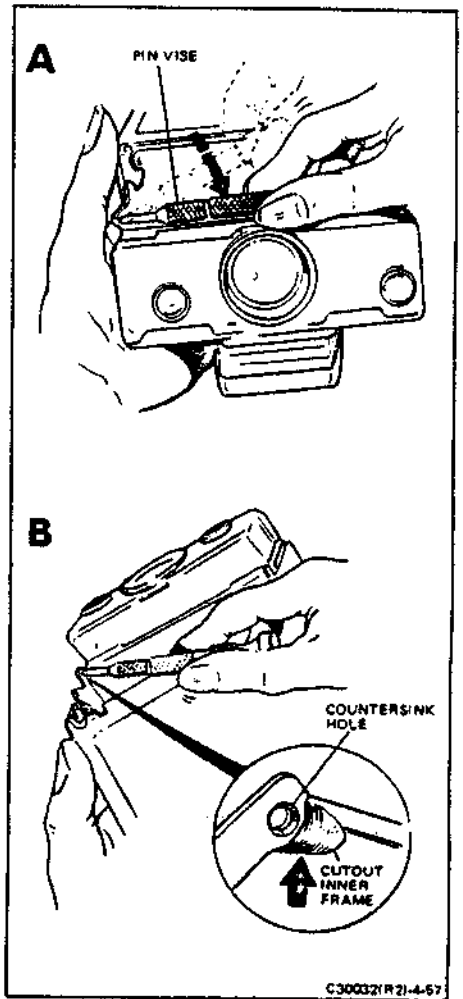


FIGURE 4-58 RIVETING THE SHUTTER HINGE BRACKET

f. Also using the #1 center drill, countersink the hole in the bottom plate assembly as shown in Figure 4-58"B".

g. Repeat steps e and f for the other side of the inner frame.

h. Align one of the pivot holes in the bracket with the corresponding countersunk hole in the bottom plate. Insert rivet #705639 from the inside of the bottom plate to secure the bracket to the bottom plate. (It may ease this operation if you temporarily secure the opposite end of the bracket with a paper clip while you rivet one side.) Flare the rivet using Special Tool #11878. Repeat this step for the opposite side of the bracket.

i. Examine the riveted area carefully: the rivet head must be flush with the side of the bottom plate and the flared side must not extend beyond .007 inch from the outside of the hinge bracket.

j. Assemble the camera and check that the rivets do not interfere with the front cover opening and closing or with film pack insertion or removal. Also, be certain that the right side rivet does not interfere with the fourth idler gear. Check that there is proper alignment when the camera is closed. As a final check, test for light leaks.

1. FRESNEL DRIVE SYSTEM ASSEMBLY

The Fresnel drive system assembly controls the Fresnel carrier through its cycle from viewing position to exposure position (and return). The system consists of two bell-crank assemblies, an actuator link, and the associated springs. These assemblies are mounted in such a way that the motor drive pinion shaft is also involved in the system functions. Faulty operation can result from broken springs, binding, distortion, or any of the malfunctions common to miniature mechanical devices. If a camera malfunction is traced to the Fresnel drive system assembly, removal and replacement can be accomplished according to the following procedures.

NOTE: (New Bell Crank Design) The removal/installation procedures below instruct you in the manner to assemble the drag link to the bell crank. These instructions pertain only to early cameras. A design change has resulted in latest cameras having a one piece assembly to eliminate angular orientation problems between two pieces. However, the new design complicates repair of the camera. When working on this area of the camera, if you have part number 705290 on hand, use it. If you have a drag link problem and have neither the pinned nor keyed parts, you will have to replace the entire lower camera back assembly. (When you do this, salvage parts from the old assembly.)

Removal

1. Erect the camera to picture-taking configuration.
2. Open and remove the front cover.
3. Remove the leather from the bottom cover and remove the cover in manner prescribed earlier.
4. Referring to Figure 4-59, remove the two override springs using tweezers.
5. By manually rotating the second idler gear in a counterclockwise direction, operate the gear-train until the Fresnel carrier swings up to the exposure position.

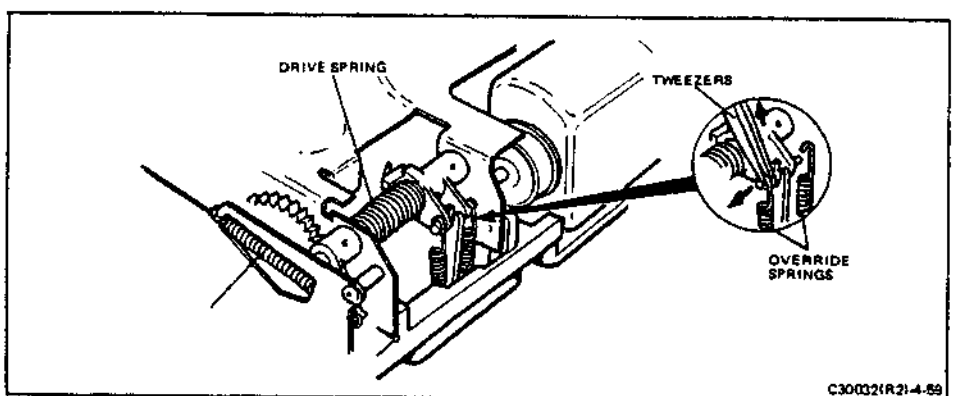


FIGURE 4-59 REMOVING OVERRIDE SPRINGS

6. Refer to Figure 4-60. Use the tweezers to catch the end of the booster spring. Stretch the spring just enough to unhook the end of the spring.

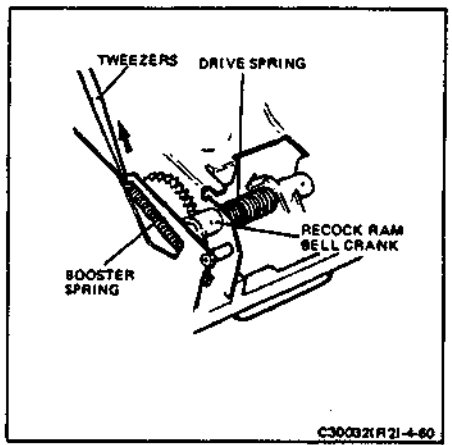


FIGURE 4-60 REMOVING BOOSTER SPRING

7. Refer to Figure 4-61. Using tweezers, slip the hooked end of the Fresnel carrier drive spring off its retainer on the drag link bell crank.

8. Refer to Figure 4-62. Remove the gear-train-assembly mounting screws. Note that three are machine screws but the fourth is a self-tapping screw. Note its location for reference.

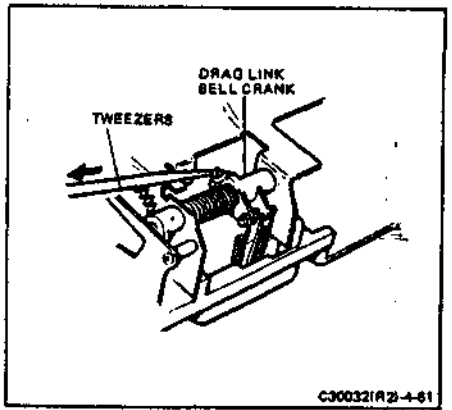


FIGURE 4-61 REMOVING FRESNEL CARRIER DRIVE SPRING

9. Invert the camera so that the outer plate (gear-train) is on the bottom.

NOTE: Do not disturb the gear-train when performing the following steps.

10. Grasp the gear-train in such a manner that the front cover latch is depressed and pull the gear-train down and away from the camera. Immediately apply a rubber band lengthwise around the gear-train to hold the gears in place while performing the following steps.

NOTE: At this point in the procedure, the gear-train is still fastened to the flex circuit. Be careful to avoid damage to the flex circuit.

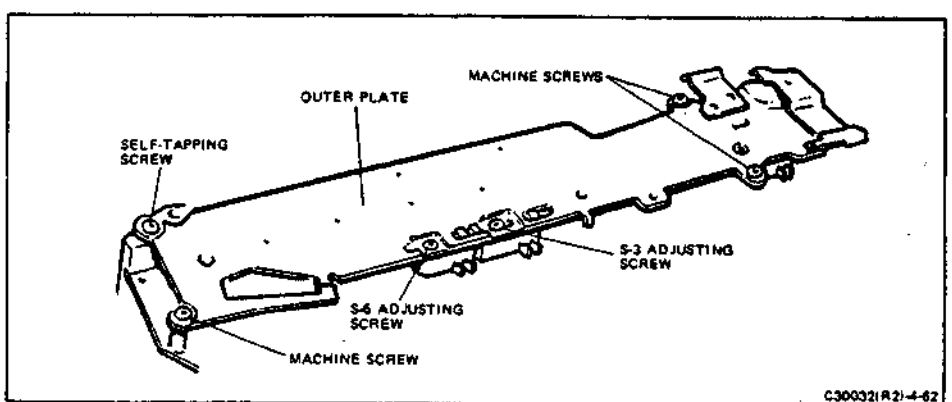


FIGURE 4-62 OUTER PLATE MOUNTING SCREWS

11. Grasp the recock-ram (Figure 4-60) bell crank. Rotate the bell crank counterclockwise until it disengages the slot in the drag link.
12. Swing the drag link away from the bell crank.
13. Rotate the recock-ram bell crank counterclockwise approximately 180 degrees to provide access to the end of the drive pin.
14. Using a miniature drift pin, push out the drag-link bell crank pin.
15. Remove the bell crank and shaft as an assembly. The drive spring will be released. The plastic sleeve will also be released.
16. Use a solder-removing tool and remove the solder from the flex circuit at each of the two motor contacts.
17. With tweezers and, if necessary, a soldering iron, lift the flex circuit from the motor contacts.
18. Using a Bristol screwdriver, loosen the two motor screws. Do not remove these screws completely since they are extremely difficult to replace.
19. With tweezers, swing the motor mount clamps free of the motor housing.
20. Grasp the MCC holder with tweezers and, at the same time, raise the contact end of the motor up. Withdraw the motor coupling spring from the plastic coupling (see Figure 4-63).
21. Span the motor pinion shaft with tweezers and press the plastic coupling from the shaft.

Installation

1. To replace the drive system in the camera, begin by sliding the pinion shaft through its bushing just far enough to permit installation of the phenolic washer.
2. Using retainer plier, Special Tool #11659, spread the grip ring and pass the pinion shaft through the ring.
3. Swing the gear train into position along the bottom plate.
4. Press the drive pinion gear against the end of the bushing and hold it firmly against the bushing. Using the special tool, spread the grip ring and slide it as close to the other end of the bushing as the tool will permit. The tool is such that, when the pressure on the pinion is released, the clearance between the pinion and bushing should be .003 to .005 inches. (Check with a feeler gage, Special Tool #11678.)

   NOTE: Whenever the motor coupling is removed, a new coupling should be installed in the camera. Do not attempt to salvage the old coupling.

5. Insert the plastic coupling into the cavity on Special Tool #11707. This must be done so the slot in the end of the coupling engages the tang in the tool.
6. Rotate the gear train so that the slot in the pinion shaft is visible. With the special tool, start to press the coupling on the pinion shaft.
7. Recock the gear train in both directions while carefully pressing the bushing onto the shaft. When the slot in the shaft is felt to be engaging the tang of the coupling, apply finger pressure to the outer face of the pinion gear and, at the same time, press the coupling on as far as it will go.
8. Remove the tool.
9. Rotate the gear train so that the slot in the coupling is visible.
10. Using Special Gage #11708 (see Figure 4-64), insert the small tip of the gage into the slot of the coupling. The opposite end of the gage should meet the inner wall of the bottom plate. If the gage will not fit as described, first try to push the bushing on a little farther. If this cannot be accomplished, remove and examine the inside of the coupling for damage and replace the coupling if necessary.
11. Rotate the motor shaft so that the tang on the drive spring will mate with the slot in the coupling. Check the mounting clamps to see that they are swung aside to clear the motor mounts. Tip the motor to direct the end of the drive spring toward the coupling. (Again, refer to Figure 4-63.)
12. Engage the drive spring with the plastic coupling and lower the motor into place.
13. Swing the motor clamps into place and tighten the two screws.
14. Visually check the gap between the drive spring tang and the bottom of the slot in the plastic coupling. Grasp the motor shaft with tweezers and remove all end play in the direction of the pinion. At the same time, press on the outer surface of the pinion gear to remove the play in that direction. The gap dimension should be approximately equal to the diameter of the spring wire.

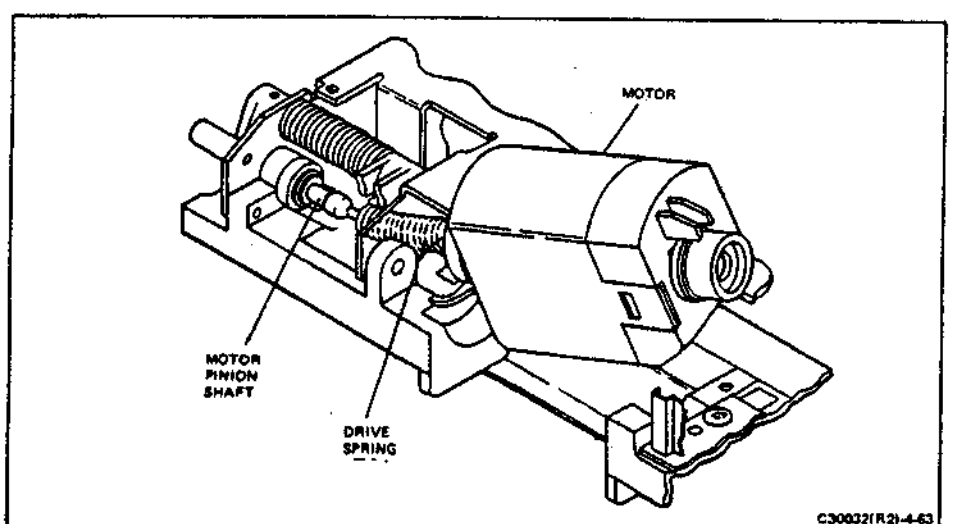


FIGURE 4-63 DRIVE MOTOR COUPLING COMPONENTS

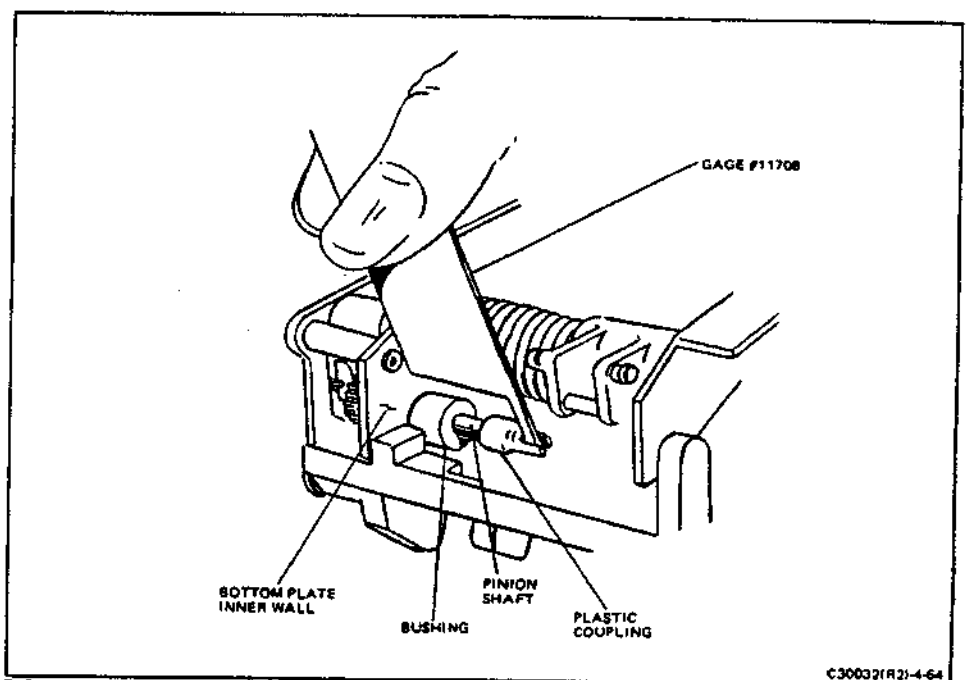


FIGURE 4-64 ORIENTING THE PLASTIC COUPLING WITH SPECIAL TOOL #11708

15. If the gap is too small or non-existent, use the small end of Special Tool #11707 to apply pressure to the end of the motor shaft (the end opposite the drive end). While holding the motor shaft against the limit of its forward travel, work the spring onto the shaft with a jeweler's screwdriver. Move the spring only enough to provide the necessary clearance.
16. If there is too much space between the drive-spring tang and the bottom of the coupling slot, the spring must be moved towards the coupling. Use the jeweler's screwdriver and carefully work the spring away from the motor housing until the gap requirement is satisfied.
17. Insert the MCC, together with its holder, into the mounting clip.
18. Use tweezers to install the flex circuit over the two motor contacts, and solder the contacts.
19. Pick up the bell crank shaft and insert the shaft through the hole in the bottom plate.
20. See Figure 4-65. Insert the plastic sleeve into the drive spring.
21. Align the sleeve (and spring) with the hole in the bottom plate. Insert the shaft into the sleeve. The end of the spring must engage the boss on the inside of the bottom plate.
22. Slide the shaft through the sleeve until the end of the shaft just begins to emerge from the end of the sleeve.
23. See Figure 4-65. Use tweezers to install the drag-link bell crank. The bell crank must be installed as shown on the illustration so that the bell crank will engage the slot in the drag link.
24. Push the shaft in until the bell crank is flush against the camera housing (see "Repairs/Adjustments").
25. Rotate the recock-ram bell crank (on the outer side of the bottom plate) in the counterclockwise direction until the hole in the shaft is aligned with the holes in the drag-link bell crank. Hold the shaft in this position. (See "Repairs/Adjustments" for more information on bell crank angle.)

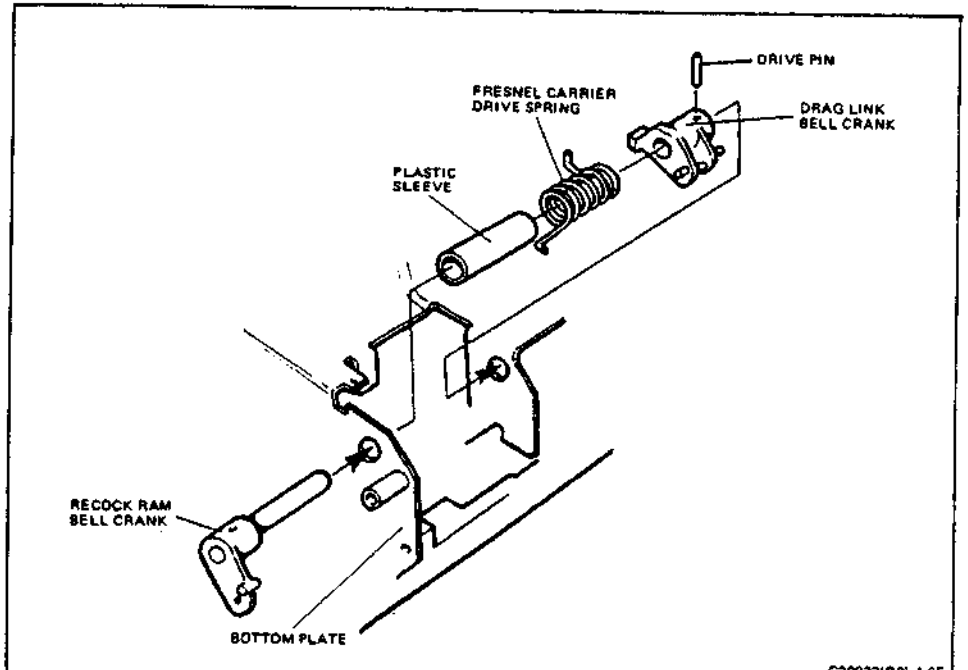


FIGURE 4-65 BELL CRANK (EARLY CAMERAS)

26. Use tweezers to insert the drive pin in the bell crank hole. Use needle-nose pliers. Press the pin into place.
27. Raise the camera and gear train assembly to eye level so that both mating surfaces can be observed. Engage the hole in the bell crank with the stud of the recock ram.
28. Slip the front cover latch over the shoulder of the brass standoff bushing (safety latch pivot).
29. Hold the gear train and the camera body tightly together. They must not be allowed to separate. Rotate the two assemblies so that the gear train is uppermost.
30. Maintaining a steady pressure against the gear-train assembly, use a dental pick and relocate the pick-latch so that the pick-latch pivots drop into their pivot holes.
31. Using the dental pick, locate the safety cam actuator in the proper place on the second idler cam.
32. Gently rock the gear-train from side to side until all the gear posts fall correctly into their pivot holes. When all pivots are correctly aligned, the plate will seat solidly and permit no further rocking action.
33. Refer to Figure 4-58. Install the three machine screws and the self-tapping screw to secure the gear-train assembly (see "Repairs/Adjustments").
34. Cut and remove the rubber band. Tighten the screws.
35. Grasp the longer end of the override spring with needle-nose pliers.
36. With the open end of the hood down, slip the closed end of the spring over one of the arms of the T-shaped drag link and into the groove in the arm.
37. Hook the longer spring extension into the corresponding groove in the arm of the bell crank.
38. In the same manner, install the second spring.
39. Engage the hook on the end of the Fresnel carrier drive spring with the notched blade of the modified jeweler's screwdriver (Figure 4-66, step 1).

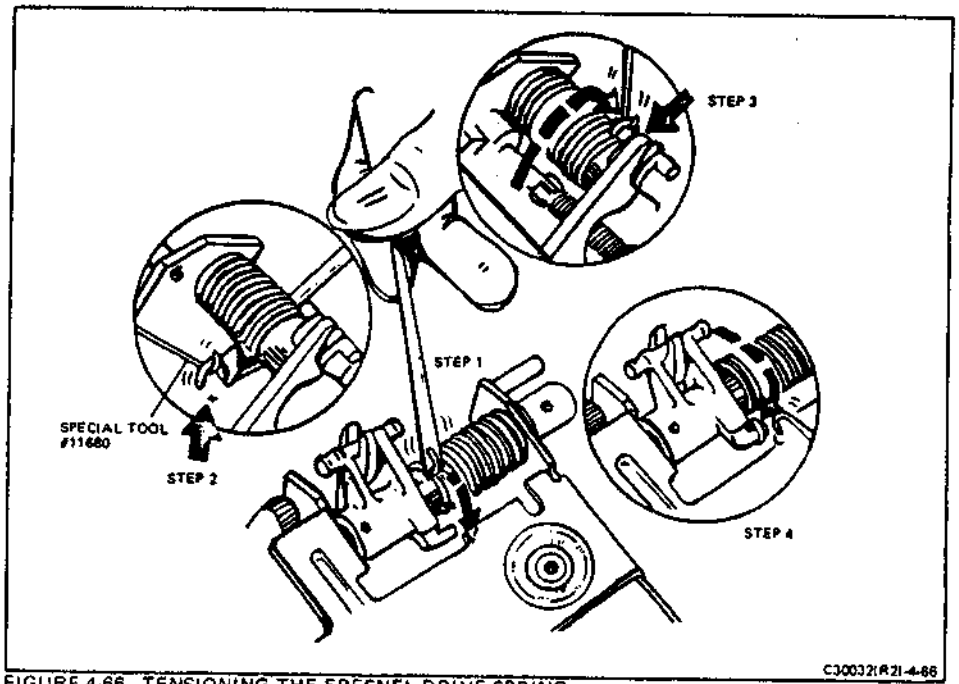


FIGURE 4-66 TENSIONING THE FRESNEL DRIVE SPRING

40. Feed the hooked end of Special Tool #11680 under the spring, engaging the tool with the hooked end of the spring (Figure 4-66, step 2).
41. Pull the end of the spring completely around and temporarily secure it on the override spring mounting lug (Figure 4-66, step 3). Put aside the pulling tool.
42. Using the notched-blade screwdriver, push the end of the spring down, securing it on the bell-crank retaining stud (Figure 4-66, step 4 and step 1).
43. Using the end of the screwdriver, slide the spring tightly against the bell crank.
44. Rotate the second reduction gear counterclockwise to actuate the gear train until the Fresnel carrier lifts to the exposure position.
45. The booster spring has one long hooked end. Hold the spring so that the open loop of the spring is toward the top of the camera. Slip the loop through the space provided and engage the loop on the stud of the bell crank.
46. Using Special Tool #11680, pull the other end of the spring down and fasten the hook of the spring on the anchor point of outer plate.
47. Continue rotating the second reduction gear counterclockwise until the mirror returns to the viewing position.
48. Check the camera for proper operation.
49. Install the bottom cover.
50. Install the front cover.
51. Replace the leather.
52. Recheck the camera.

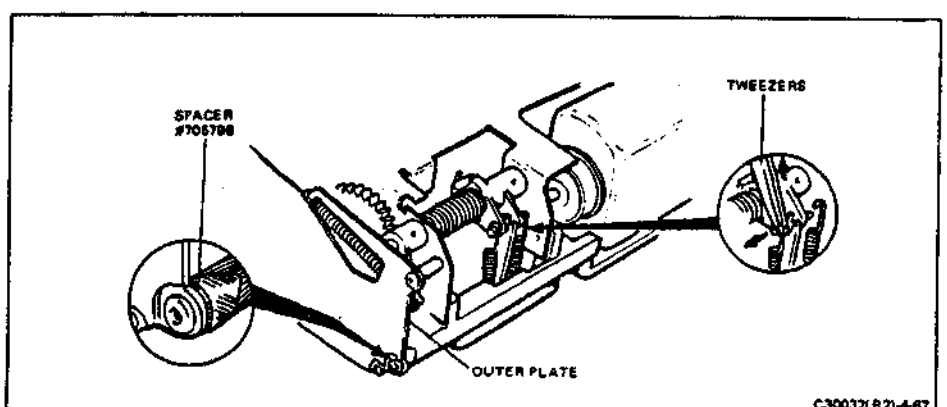


FIGURE 4-67 RECOCK RAM BINDING MODIFICATION

Repairs/Adjustments

1. Recock Ram Binding (Refer to Figure 4-67)

On some cameras, a delay in the time between pressing S1 and the raising of the Fresnel assembly causes the recock ram to bind against the outer plate at the bell crank shaft connection. To confirm the existence of this problem, see if the end of the Fresnel drive spring (nearest the recock ram) slips between the sleeve and the bottom plate

To overcome this problem, install a spacer (part number 705798) on the outer plate under the mounting screw shown in Figure 4-67. This shims the outer plate 0.007" away from the inner frame.

2. Outer Plate Mounting (Cable Clamp Repair)

In making repairs to the camera or any accidental dropping of the camera could damage the metal studs used to secure the cable restrainer to the outer plate. This procedure tells you how to solve this problem without replacing the whole bottom plate. (Refer to Figure 4-68.)

a. If one stud is damaged, A or B, obtain a self-tapping screw, #705169, the same as used in mounting the outer plate.

b. Cut the screw, leaving a shaft length of about 3/4" to one thread.

Caution: The shaft *cannot* exceed beyond the plate when it is tightly secured. (Shaft length of .035" maximum.) If the screw is too long, it could interfere with the front latch or other components in the same area.

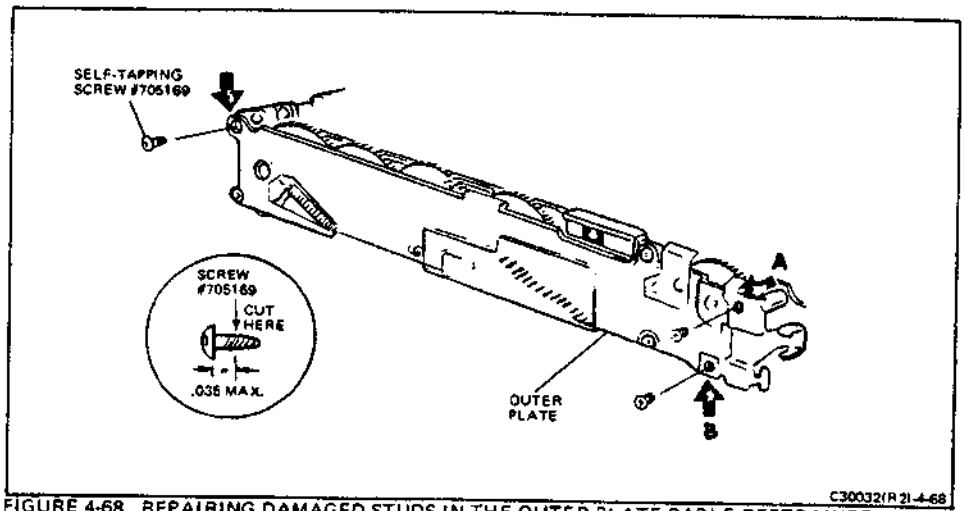


FIGURE 4-68 REPAIRING DAMAGED STUDS IN THE OUTER PLATE CABLE RESTRAINER

c. Use the shortened screw to secure the clamp. Coat the shaft with Eastman 910 adhesive. (Use very little – no spill off is allowed.)

d. If both studs are damaged, use another screw in exactly the same way for the other hole.

e. If, by chance, the clamp was pulled away from the stud without damage to the stud, it will be necessary to file down the stud and then drill it out with a #56 drill. (This is needed to provide a hole in the outer plate to enable the above fix to be used.) Use caution while drilling the stud to prevent damage to any other components and be sure to remove all filings.

f. Reassemble the camera and check for smooth front cover action.

J. FRESNEL CARRIER (Including Drive Pawl and Drag Link)

The Fresnel carrier is the swinging mount for both the Fresnel screen and the exposure mirror. The surfaces of both the screen and the mirror are extremely delicate and are, thus, easily damaged. If the taking mirror surface has been damaged or soiled, the quality of the pictures will be degraded and the Fresnel carrier must be replaced. The mirror may be cleaned with Kodak lens cleaner. (However, the Fresnel cannot be cleaned.) Be sure all cleaner is removed after cleaning. Otherwise, a residue on the mirror will interfere with focusing or viewing.

Both the drive pawl and the drag link are subject to wear during camera use and, since the Fresnel carrier must be removed to provide access to these two components, their removal and replacement procedures are included in these paragraphs.

Removal

1. Erect the camera to picture-taking configuration.
2. Open and remove the front cover.
3. Remove the leather from the bottom cover and remove the cover as previously instructed.
4. Release the mirror cover/boot assembly from the camera as follows:
   (a) Remove the mirror cover/inner frame hinge pins using Special Tool #11654.
   (b) Identify the two (or three) boot retainer screws on the roof of the film compartment and remove them.
   (c) Insert boot remover tool #11698 into the film compartment and release the boot tabs from the inner frame.
   (d) Slide the erecting link free of the slot.
   (e) Reinstall the front cover and place it in the raised position.
   (f) Swing the entire mirror cover/boot assembly forward, cradling the shutter in the front cover.

(g) Lock the assembly in the raised position as shown in Figure 4-68"A" by setting the erecting link into the slot between the front cover and the inner frame.

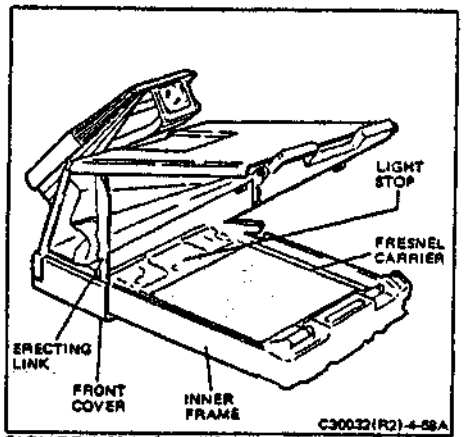


FIGURE 4-68A CAMERA PARTIALLY DISASSEMBLED FOR ACCESS TO INNER COMPONENTS

5. At this point, the light stop may be replaced if this is the only reason the camera was disassembled. Proceed as follows: (If other repairs must be made, continue with step 6.)
   (a) Carefully peel off the old light stop.
   (b) The stock light stops have adhesive already applied. Peel off the backing paper and press the light stop into position on the carrier. Avoid wrinkles or creases. The location of the light stop is critical; if not precisely positioned, the camera might have a failure similar to an intermittent S3 mode function. Replace the light stop in the correct location (see Figure 4-69).

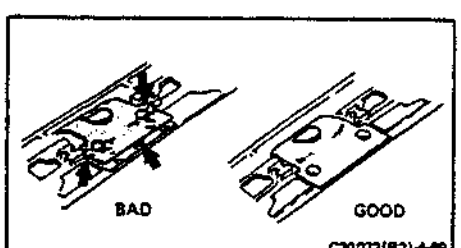


FIGURE 4-69 FRESNEL LIGHT STOP POSITION

6. Using tweezers, remove the two override springs from the drag link bell crank (refer back to Figure 4-59).
7. Using Special Tool #11664, press out the two Fresnel carrier hinge pins.
8. Release the safety latch (if camera has one) and lift off the Fresnel carrier. If the carrier is to be reused, place a protective sleeve around the Fresnel carrier to prevent damage to the mirror or the Fresnel screen.
9. At this point, the drag link may be replaced if needed. Do this as follows, referring to Figure 4-70:
   (a) Use a miniature drift pin or Special Tool #11662 and drive the pivot pin just far enough to clear the drag link.
   (b) Place the replacement drag link into position.
   (c) Use parallel-jaw pliers and press the pin into place so that the ends are flush with the casting.
10. To replace the drive pawl (see Figure 4-70) and its spring, proceed as follows:
   (a) Use tweezers to release the drive pawl spring.
   (b) Use a miniature drift pin and drive the pivot pin far enough to clear the drive pawl (Special Tool #11662).
   (c) Install the spring on the replacement drive pawl.
   (d) Set the pawl and its spring into position and drive in the pivot pin until its end is flush with the casting.
   (e) Engage the end of the spring in its slot in the pawl.

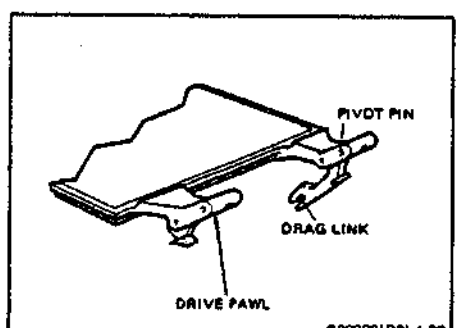


FIGURE 4-70 DRAG LINK & DRIVE PAWL

Installation

NOTE: New Fresnel carriers operate without a safety latch, actuator or spring and require new override springs. Beginning with cameras having split image fresnel assemblies, the changes are mandatory. The safety latch must be removed from the bottom plate. Its actuator and spring may be left in place providing that the spring tensions the actuator. Also, with customer approval, the new split-image Fresnel screen should be installed (see "Repairs/Adjustments"). Before installing the carrier, lubricate the drag link slotted opening with Lubriplate.

1. Hold the Fresnel carrier in such a position that the drag link hangs straight down.
2. (When performing this step, be careful that the drag link does not disturb the position of the motor drive coupling spring on its shaft.) Lower the Fresnel carrier in such a manner that the slot in the drag link will engage with the cross bar of the bell crank.
3. Tilt the corner of the Fresnel opposite the drag link just enough to be able to get to the drive pawl tension spring. Engage the pawl spring with a dental pick to guide it into the pawl cavity. Push it in (while applying tension) as far as it will go. At the same time, lower the Fresnel until the hinge pin holes are aligned.
4. Press the hinge pin into place on the inner frame so that the end of the pin is flush with the surface of the casting.
5. In like manner, install the hinge pin on the drag-link side of the carrier.
6. Carefully depress the carrier by hand while examining the two hinge areas to make certain there is no interference or binding.
7. Remove the protective sleeving from the Fresnel carrier.
8. If an old style, non split-image camera, check the safety latch to make sure that it has correctly captured the carrier. (Remember, split-image Fresnels have no safety link.)
9. Check the drag link. It should be engaged with the drag link bell crank. If not, use needle-nose pliers and engage the drag link.
10. With the needle-nose pliers, grasp one of the override springs at its longer extension. Hook the smaller loop of the spring over one of the arms of the T-shaped drag link and into the groove in the arm.
11. Hook the longer spring extension into the corresponding groove in the arm of the bell crank.
12. In the same manner, install the second spring.
13. By rotating the second reduction gear in the counterclockwise direction, operate the gear train through one complete cycle to check proper operation of the system.
14. Set the mirror cover into position and insert the roller on the end of the erecting link into the hole at the end of the curved slot. Slide the link into position.
15. Lower the mirror cover so that the free-hanging actuator passes through the cutout in the inner-frame assembly toward the S6 contacts.
16. Carefully lower the cover into place.
17. Snap the boot retainer into place by applying finger pressure to the two points indicated on Figure 4-71.

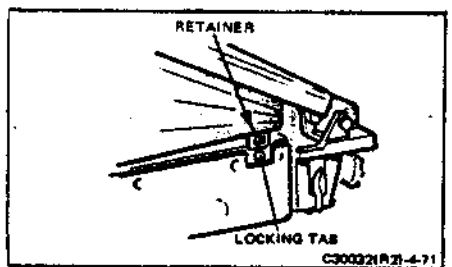


FIGURE 4-71 BOOT RETAINER

18. Reinstall the two mirror-cover to short-cover hinge pins and raise the Fresnel assembly.
19. Install and tighten the inner-frame to boot retainer screws.
20. Slide the bottom cover into place.
21. Install and tighten the four cover retaining screws.
22. Check camera operation before proceeding below.
23. Replace the decorative leather covering on the bottom cover.
24. Install the front cover.
25. Close the cover and check the camera operation.

Repairs/Adjustments

1. Fresnel Carrier Spacer/Entrance Pupil Horizontal Displacement

In Section 3, one of the troubleshooting procedures concerns entrance pupil horizontal displace-

ment. If the pupils are horizontally displaced, a spacer (part number 705798) is available to correct the problem. After removing the Fresnel carrier install the spacer as follows:

NOTE: The spacer is installed only on the left hinge pin.

With the assembly positioned so that the Fresnel screen in on top, install the left side hinge pin by starting the pin through the hole in the frame, then through the Fresnel carrier hinge. Add the spacer before pushing the pin through the right side frame hole (see Figure 4-72). In this position the spacer moves the Fresnel away from the gear train. To move the carrier in the other direction, insert the spacer on the left side of this hinge. When completing this repair, retest the camera.

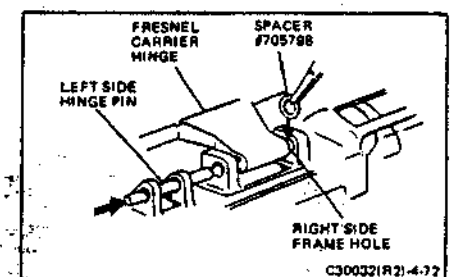


FIGURE 4-72 CORRECTING HORIZONTAL DISPLACEMENT OF THE FRESNEL

2. Fresnel Carrier Warping

If the previous procedure still does not bring the entrance pupils into horizontal alignment, examine the carrier. If it is warped, try to gently bend it to correct the problem. If it does not help, replace the entire carrier assembly.

3. Fresnel Carrier Seating (Split Image Fresnels)

If excessive shadow appears on the split-circle image, examine the Fresnel carrier for a small ridge of flashing (in the area shown in Figure 4-73). This flashing could keep the carrier from properly seating on the inner frame. If the flashing is there and can't be removed, replace the carrier.

A second area of examination is also necessary when installing a split-image Fresnel. Check the inner frame. On very early camera models, two ears are present on the inner frame (Figure 4-74). If an early model inner frame, use an Xacto knife to cut these ears off as shown in Figure 4-71.

Also, be certain that new override springs – #705902 are used with the new drag link – #705897 on the Fresnel carrier.

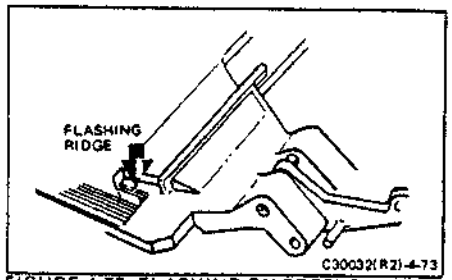


FIGURE 4-73 FLASHING ON FRESNEL CARRIER

After installing the split-image Fresnel, test the camera according to the instructions in Section 3, Troubleshooting.

4. Split-Image Matchups

NOTE: Refer to paragraph E4 for instructions on converting plain Fresnels to split-image Fresnels.

When installing a split-image Fresnel, examine the short cover for the following components which must be used with the split-image:

a. Concave mirror (with retainers)
b. 3° tilted eyelens
c. Wafer lens

If the examination reveals that the new concave mirror and 3° eyelens are in place, but there is no wafer lens, replace the entire short cover assembly. If the examination shows that the wafer lens is present but the new concave mirror and 3° tilted eyelens are not, modify the short cover by installing a new mirror and a new eyelens to go along with the wafer lens.

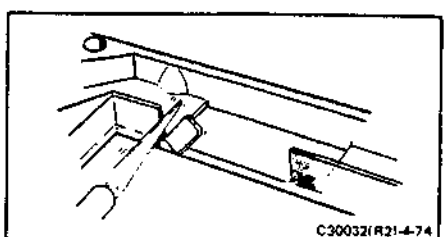


FIGURE 4-74 REMOVING "EARS" FROM EARLY INNER FRAMES

NOTE: If in the course of checking the optics system you note that the entrance pupil is vertically out of specification, perform the erecting link adjustment called for in paragraph D.

K. LIGHT BAFFLE

The light baffle function is to stop unwanted light from reaching the film during the exposure portion of the operating cycle. If the baffle has been distorted or if it fails to function because of binding, a broken spring, or other malfunction, undesireable flare will appear on the pictures. The following paragraphs describe the procedure for removal and replacement of the baffle.

NOTE: Before disassembling the camera to replace an apparently defective light baffle, examine the camera to determine if the problem is caused by bent baffle ears. If it is, the baffle can be repaired without removing it from the camera. Refer to "Repairs/Adjustments" at the end of this section.

Removal

1. Open and remove the front cover.
2. Remove the bottom cover as previously instructed.
3. Remove the boot as previously instructed.
4. Remove the shutter bracket pivot pins and swing the entire upper camera back to one side. Use care to avoid damage to the ribbon cable.
5. Remove the gear train cover and rotate the second reduction in a gear counterclockwise direction until the Fresnel carrier swings up into the exposure-mode position. Cover the Fresnel with a protective cover.
6. Use duck-bill or needle-nose pliers: grasp the light baffle hinge pin and bend it to a 90° angle. See Figure 4-75. Use a small peen hammer and knock the pins inboard, striking the tool while holding the bent end of the pin. Remove the left-hand (viewed from rear) pin first. Remove the spring and light baffle by sliding off the right-hand pin.

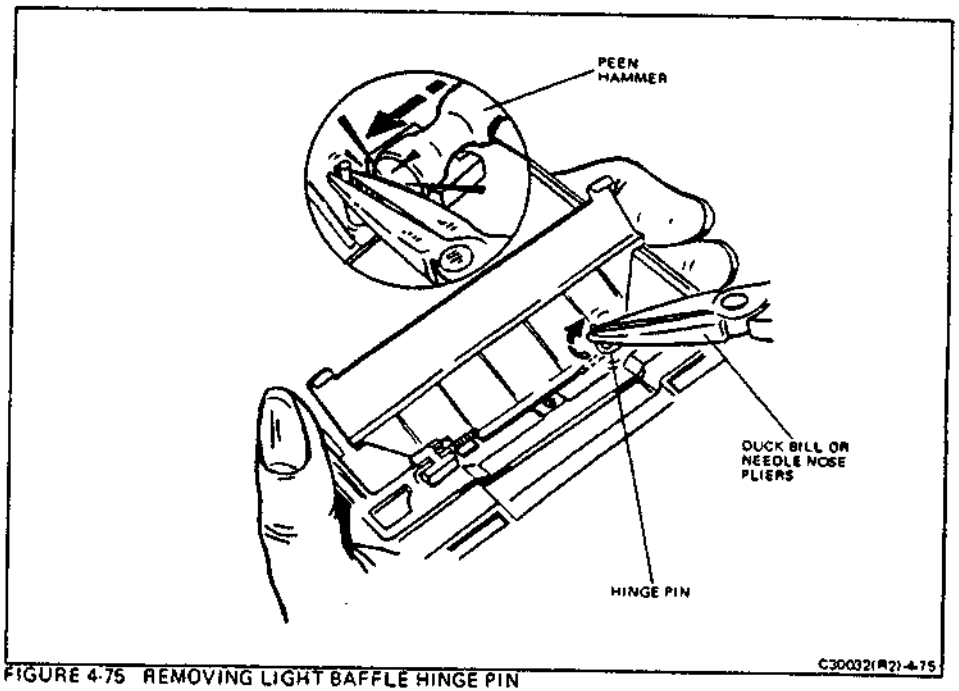


FIGURE 4-75 REMOVING LIGHT BAFFLE HINGE PIN

7. Lift out the baffle.

Installation

1. Position the new baffle in the camera, ready for installation.
2. Using tweezers or needle-nose pliers, insert the end of the pins into the hinge holes from the center of the camera (Figure 4-76).
3. Install the baffle with its spring on the right-hand pin. Use pliers with one jaw on the outside of the hinge post and squeeze the pin outwards until it reaches the stop (Figure 4-76).

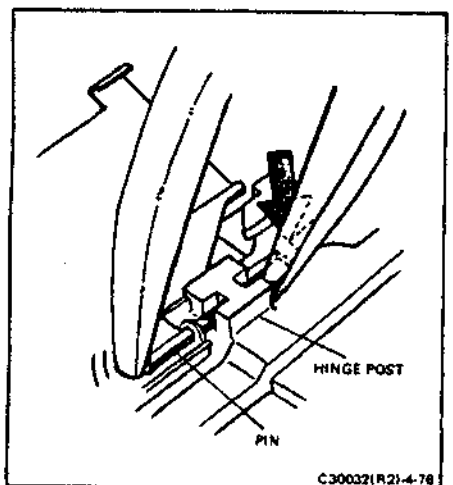


FIGURE 4-76 USING PLIERS TO INSERT LIGHT BAFFLE HINGE PIN

4. Refer to Figure 4-77. Install the spring on the right-hinge pin.
5. Engage the shorter of the two spring extensions into the slot on the lip of the baffle (Figure 4-77).
6. Use a dental pick or other suitable tool and hook the longer spring extension into the slot provided for it on the inner frame (Figure 4-77). Check the spring action of the baffle. It must be completely free – no evidence of binding is tolerable. Also, when in the raised position, the baffles should rest uniformly on the baffle stops of the inner frame.
7. Remove the protective sleeve from the Fresnel carrier and manually rotate the gear train to lower and latch the Fresnel.

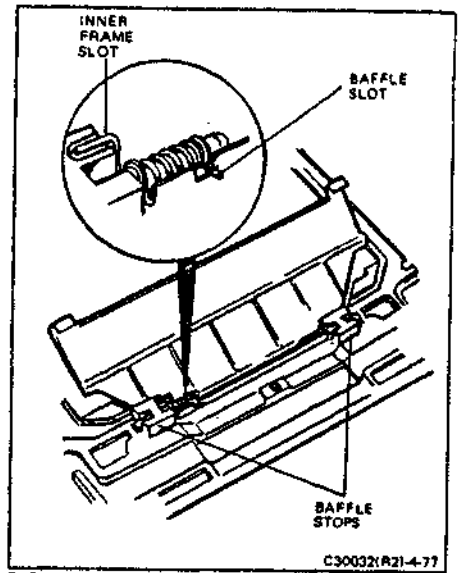


FIGURE 4-77 BAFFLE HINGE SPRING

8. Swing the upper camera back into its normal position and install the shutter bracket pivot pins.
9. Reinstall the mirror cover/boot assembly as previously instructed.
10. Manually rotate the second reduction gear in the gear train in a counterclockwise direction, until the mirror is in the exposure position. Reinstall the gear train cover.
11. Reinstall the bottom cover and check the camera.
12. Replace the front cover.
13. Replace the leather on the bottom cover.

Repairs/Adjustments

1. Oil on Baffles

Some light baffles may be received with oil on the surface. The oil will dirty the taking mirror, producing a shadow on the bottom of the pictures. In this case, change the baffle and clean the dirty mirror with lens tissue and/or Q-tip moistened with lens cleaner. Also check whether oil has been deposited on the inner frame and, if found, remove.

2. Bent Baffle Ears (Tabs)

As mentioned at the beginning of this paragraph, bent baffle ears can be repaired without disassembling the camera. Do this as follows:

a. Remove the front cover.
b. Make sure that the Fresnel carrier is down, in the viewing position.
c. Hold the camera bottom up and look inside the film compartment. The light baffle is visible toward the front edge of the film compartment.
d. Insert the tool with the slotted, right-angled end first, parallel to the bottom of the baffle.
e. Keep the long handle of the tool handle aligned with the side of the baffle and slide the end to the inside of the camera, thereby catching the baffle in the slot (Figure 4-78).
f. Push the tool away from you, gently, until you feel the resistance caused by the curl at the end of the ears.
g. Once seated as described, push the handle end of the tool up just enough to touch the edge of the bottom cover.
h. Without putting angular stress on the baffle, slip the tool toward the outside of the camera and carefully remove.
i. Repeat the same process on the other side to be certain that both ears have the same correct bend.

L. EXPOSURE COUNTER

The exposure counter registers the number of pictures remaining in the camera. An obvious indication of malfunction would be its failure to correctly register the remaining pictures.

Among the possible failures are the following:

1. Switches S8 and S9 are integral components of the counter assembly and if they become defective, the counter assembly must be removed and replaced.

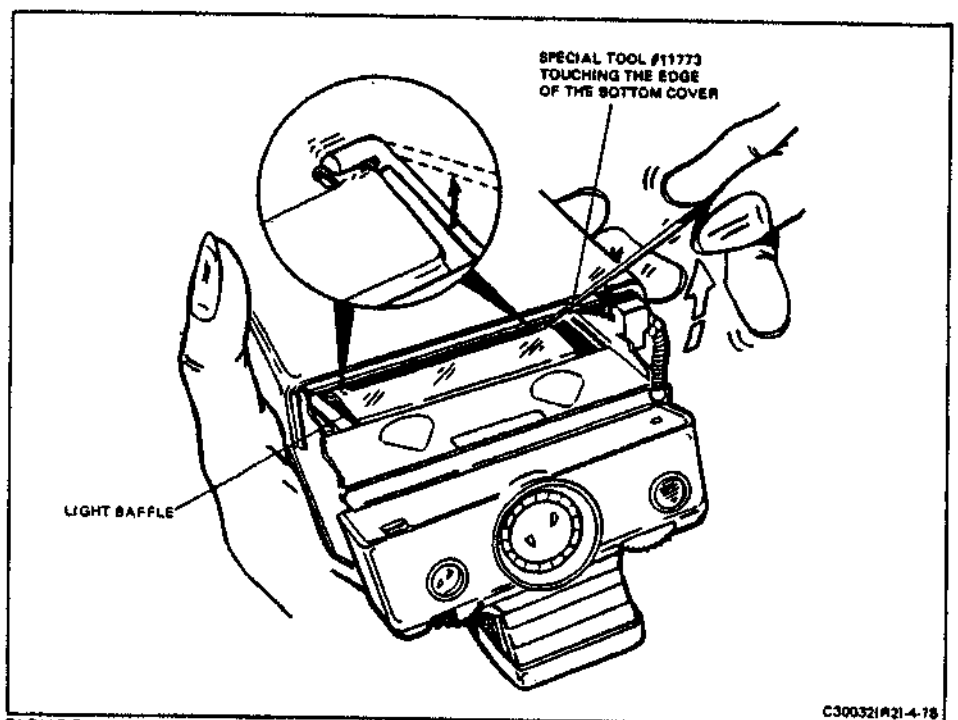


FIGURE 4-78 BENDING LIGHT BAFFLE EARS

2. The spring contacts of switches S8 and S9 can suffer fatigue. The contact points, as in any switch, can become dirty or corroded. If other repairs require electrical disconnection of S8 and S9, the switches can be damaged by improper soldering techniques. Whatever the malfunction or its cause, the counter must be removed and replaced.
3. The counting mechanism is subject to wear and damage in the ratchet/pawl areas. Ratchet teeth may become worn or damaged. The drive pawl and/or reset pawl can be broken or their mounting points worn or damaged.
4. If repairs are performed in the MCC area, it is possible to damage the clip which supports the MCC holder.

Removal and replacement of the counter is accomplished in the following manner:

Removal

1. Open and remove the front cover.
2. Peel the leather from the bottom cover and remove the bottom cover according to previous instructions.
3. Insert an empty film pack to prevent solder from entering the film chamber, and to set the counter mechanism in a configuration necessary to permit its removal.
4. Using the specified soldering iron and solder-removing device, unsolder the three S8/S9 counter switch contacts from the flex circuit (Figure 4-79).

NOTE: Newer counters have a different pattern of contacts as shown by the inset in Figure 4-79.

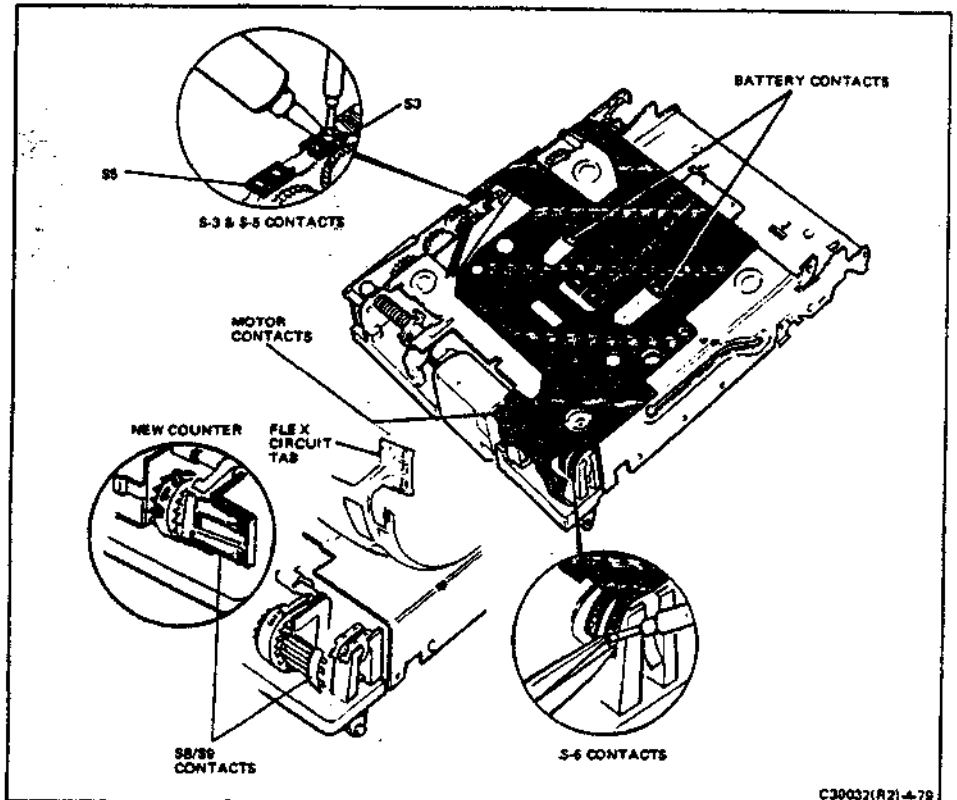


FIGURE 4-79 SOLDER POINT IDENTIFICATION

5. Use tweezers and lift off the flex circuit tab.
6. In like manner, unsolder the two S6 contacts.
7. Using tweezers, slide the MCC holder out of its mounting clip.
8. Carefully roll back the flex circuit just enough to provide access to the counter screws.
9. Remove the two screws which secure the counter assembly to the inner frame (see Figure 4-80).
10. Grasp the MCC mounting clip with tweezers and lift out the counter.

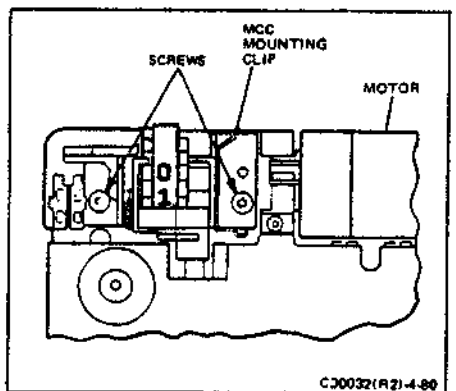


FIGURE 4-80 COUNTER BRACKET SCREWS

Installation

NOTE: As already noted, a new type of counter is available. The older type has the three switch contacts lined up in a row while the newer style has the middle contacts offset from the other two. Try to replace the defective counter with one of the same type to facilitate soldering.

1. Before installing the counter, identify the drive pawl which is a part of the Fresnel carrier and the metal reset pawl on the counter.
2. Holding the counter as shown in Figure 4-81, guide the flat tongue of the reset pawl into the forked end of the reset pawl spring in the film compartment. Simultaneously, rotate the drive pawl (using a dental pick) so that it enters the cavity in the inner frame.
3. Once the reset pawl starts to enter the forked reset pawl spring, continue to lower the counter onto the inner frame while sliding the dental pick free of the assembly. Set the counter

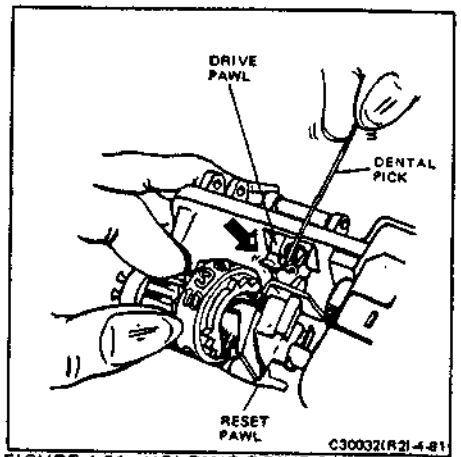


FIGURE 4-81 HOLDING DRIVE PAWL DURING COUNTER INSTALLATION

brackets over the locating pins. (Note that the brackets have holes for both locating pins and mounting screws.)

4. Install and tighten the wet mounting screws (see "Repairs/Adjustments").
5. Check the operation of the counter. Manually rotate the counter to 0 on the dial. Remove a and reinstall the film pack. The counter should return to its starting position. Check for mechanical binding. Check the reset pawl.
6. Slide the MCC holder into its mounting clip. Make certain that the insulating tongue of the flex circuit is in position between the MCC contacts and the motor frame. If the tab has been dislodged, carefully reinsert the tab.
7. Using tweezers and pressing lightly, bend the flex circuit so that it meets the three contacts at S8 and S9 with a small-radius bend.

NOTE: If an older counter is replaced with a new counter, or vice versa, and the flex circuit is not changed, a jumper wire will have to be used to join the middle S8/S9 contact with its corresponding contact on the flex circuit.

8. Using tweezers, position the flex circuit over the three S8/S9 contacts. Span the contacts with the tips of the tweezers (one contact at a time) and press the circuit over the contacts so that each contact protrudes through the solder pad of the flex circuit.
9. Solder the three contacts.

10. In the same manner as above, connect and solder the flex circuit to the two S6 contacts.
11. Remove the empty film pack and check the camera for proper operation.
12. Install the bottom cover in accordance with previous instructions. (Do not install the leather yet.)
13. Install the front cover.
14. Check camera operation.
15. Install the decorative leather on the bottom cover.

Repairs/Adjustments

1. New Counter Information

The new counter design (Figure 4-82) assures better S8/S9 operation. Note that the pattern of three contact points is different from the previous counter. To interchange counters, the flex circuit contacts must mate with the new pattern on the counter. This can be done by using a jumper wire.

The contacts are closed by a cam molded on the counter wheel. Figure 4-82 shows S8 closed, before film pack insertion. When the wheel rotates to "0", the same cam will close S9.

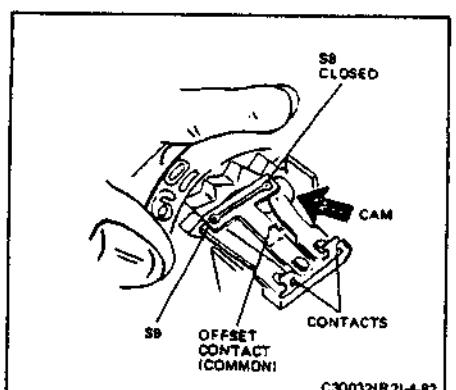


FIGURE 4-82 NEW COUNTER DETAILS

2. Mounting Screw Lengths

Some bottom plate assemblies have counter mounting screw holes deeper than others. If the usual screws do not hold the counter tightly, use a slightly longer screw, (part number 705497). This screw is to be used for repair only and only when needed.

M. MOTOR ASSEMBLY

The motor is the prime mover of the SX-70 camera. If the motor fails to operate, none of the normal camera functions can occur. A number of reasons can be the cause of motor failure but the most obvious, and sometimes ignored, is loss of power as a result of battery failure. Before any other troubleshooting or testing is attempted, check motor operation with a film pack containing a battery of known value or with the film pack simulator.

Motor failures can be caused by two general types of malfunction. The first can be described as mechanical; gears jammed or overloaded, mechanical linkages deformed, dirt on moving assemblies, etc. The second general category involves electrical malfunctions, dirty contacts, shorts, or open circuits, faulty MCC, switches, etc. Testing and troubleshooting procedures will isolate the motor as the faulty component. Removal and replacement is accomplished in the following manner.

Removal

1. Open and remove the front cover.
2. Remove the leather from the bottom cover and remove the cover.
3. Insert an empty film pack to prevent solder and/or rosin splashes from entering the film chamber.
4. Using the specified soldering iron and solder-removing device, unsolder the two motor contacts from the flex circuit.
5. Use tweezers and lift off the flex circuit tab. Use tweezers and slip the MCC holder out of its retaining clip.
6. Carefully roll back the flex circuit just enough to provide access to the motor retaining screws.
7. Figure 4-83 compares the old motor clamp.

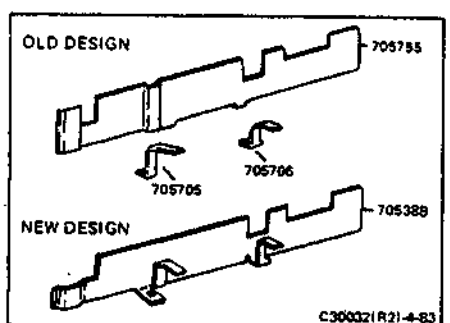


FIGURE 4-83 LOADING PLATES/MOTOR CLAMPS

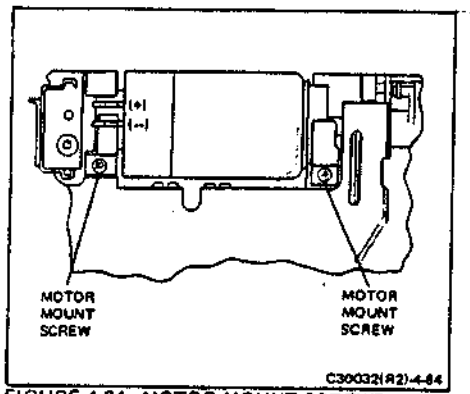


FIGURE 4-84 MOTOR MOUNT SCREWS

plate with the new motor clamp plate. On newer cameras, the motor is secured by two clamps which are a part of the loading plate inside the camera. (These cameras are easily identified by looking into the film compartment. If the loading plate has no blue and yellow decal, the camera is a newer model. If the loading plate has a yellow and blue decal, the camera is an older model with individual motor clamps.) To remove the motor on newer cameras, identify the loading plate mounting screws and loosen them. Do not remove them to replace the motor. Loosen them just enough to allow the motor to be swung free of the clamps.

To remove the motor on older cameras, identify the motor mount screws (Figure 4-84) and loosen them just enough to allow the clamps to be swung away from the motor.

8. Slowly lift out the end of the motor that includes the two electrical contacts. The coupling spring is sufficiently flexible to sustain a relatively sharp-radius bend without damage.
9. Carefully withdraw the motor so that the coupling spring slips from the plastic coupling.
10. Remove the motor and coupling spring.

Installation

1. Before installing the motor, it is imperative that the coupling spring position be critically checked. Use the two piece flex coupling gage (Special Tool #11679). Place the gage as shown on Figure 4-85. The end of the coupling spring should be flush with the end surface of the gage. If the spring extends beyond the gage, leave the motor on the bottom (support) end of the gage. Lift off the upper half of the gage and use a jeweler's screwdriver to move the spring further onto the shaft. If the spring does not reach the end of the gage, remove the gage and, using a jeweler's screwdriver, work the spring further from the motor flange.

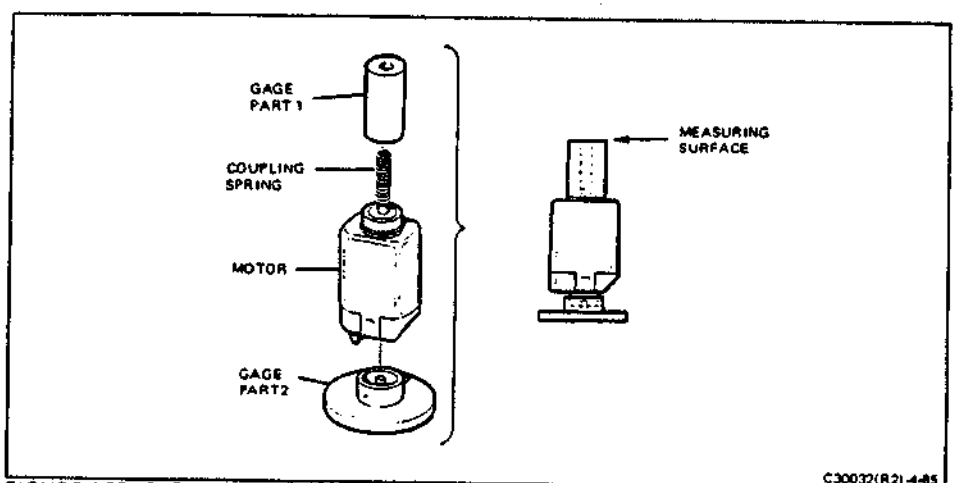


FIGURE 4-85 FLEX COUPLING GAGE

2. Refer to Figure 4-86. Hold the motor as shown. The motor pinion shaft can be rotated by manually operating the gear train. Rotate the shaft so that the cross tang on the coupling spring is correctly aligned with the slot in the coupling. (Use a new plastic coupling whenever installing a motor.)

3. Slide the coupling spring into the slot of the plastic coupling as the motor is placed into position. Seat the two motor shock mounts into the semicircular mounting sockets in the housing.

4. Tighten the clamp screws or the loading plate screws, depending on the camera model.

5. The motor can be rotated very slightly in its clamps. Examine the installation carefully while rocking the motor slightly in its mountings to make sure the motor is properly seated. Recheck and, if necessary, retighten the mounting screws.

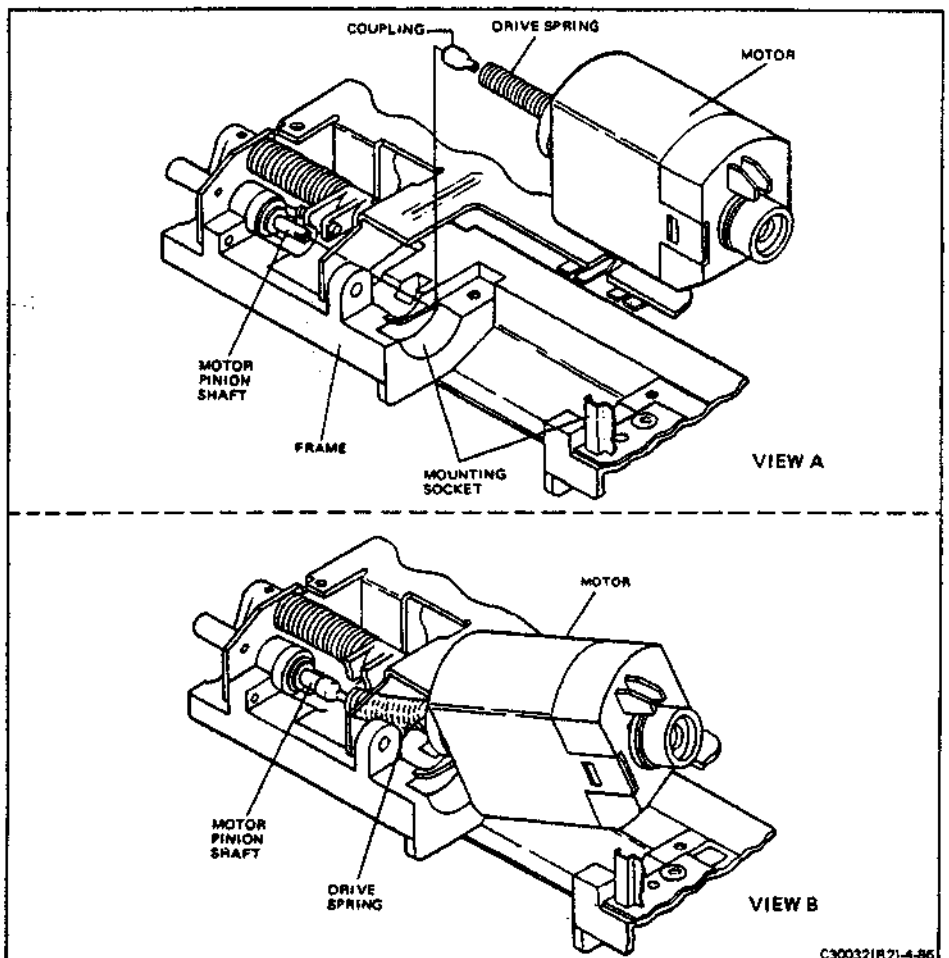


FIGURE 4-86 MOTOR INSTALLATION

6. The outer plate (gear train) must be firmly seated against the surface of the inner frame before the following checks are made. If necessary, tighten the outer-plate mounting screws. Manually rotate the gear train so that the slot in the motor pinion shaft can be seen.

7. Grasp the pinion shaft with tweezers and move the shaft toward the motor as far as the end play will permit.

8. Release the pinion shaft and grasp the motor shaft between the end of the coupling spring and the motor mount.

9. Visually check the gap between the drive-spring tang and the bottom of the slot in the plastic coupling. (Grasp the motor shaft with tweezers and remove all end play in the direction of the pinion. At the same time, apply pressure to the outer surface of the pinion gear to remove play in that direction.) The minimum gap dimension should be approximately equal to the diameter of the spring wire.

10. If the gap is too small, remove the motor assembly and repeat steps 1 through 9.

11. After the motor is checked, slide the MCC holder into its mounting clip. Make certain that the insulating tongue of the flex circuit is in position between the MCC contacts and the motor frame. If the tab has been dislodged, carefully reinsert the tab.

12. Locate the flex circuit extension that reaches the two motor contacts, Figure 4-87. Using tweezers, press the flex circuit over the motor contacts until the contacts protrude through the flex circuit. If this step is performed correctly, the flex circuit will be held securely in place on the two motor contacts.

13. Solder the two motor contacts.

14. Check the camera manually and electrically for proper operation.

15. Slide the bottom cover into place.

16. Install and tighten the four cover retaining screws.

17. Check the camera for proper operation.

18. Replace the decorative leather covering on the bottom cover.

19. Install the front cover.

20. Close the cover and check the camera.

N. FLEX CIRCUIT

The Flex Circuit is a flexible printed circuit that

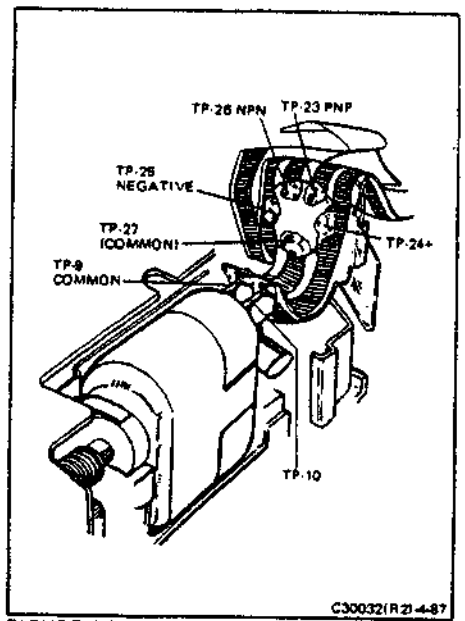


FIGURE 4-87 MCC TO MOTOR CONNECTIONS

provides the electrical interconnections throughout the camera. Once in place, it is not subject to damage from camera mishandling. Likewise, wear is not involved. For these reasons, removal and replacement of the flex circuit will only be required if the circuit is damaged when other repairs are performed, or when sections of the circuit or the complete circuit must be removed to gain access to other components. The flex circuit is removed and replaced in the following manner.

Removal

1. Open the camera and remove the front cover.

2. Remove the leather from the bottom cover.

3. Remove the bottom cover as instructed earlier.

4. Unsolder the shutter cable leads from the flex circuit. Use an Xacto knife with the soldering iron and follow the procedure outlined in paragraph F covering the "Shutter Assembly".

5. Once the cable is removed, turn the camera over and place it face down on the workbench.

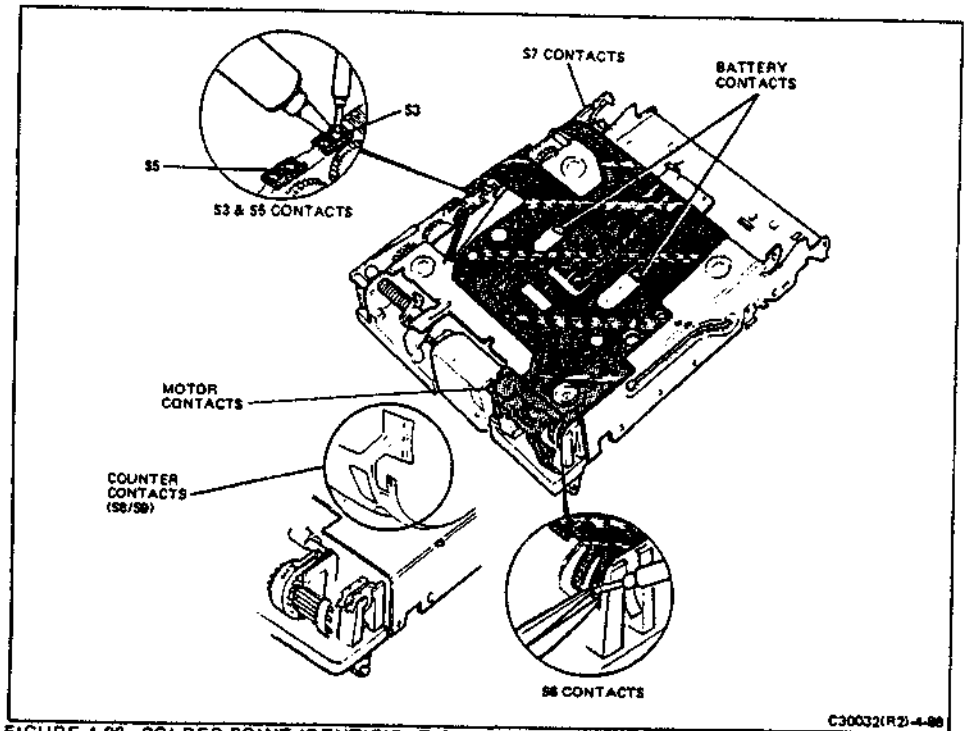


FIGURE 4-88 SOLDER POINT IDENTIFICATION

6. Referring to Figure 4-88 for the location of flex circuit contacts, unsolder the following contacts: (Use a solder-gobbler with the soldering iron and tweezers to help separate the contacts.)
   (a) Unsolder the two battery contacts.
   (b) Unsolder the two S6 contacts.
   (c) Unsolder the three S8/S9 contacts from the counter.
   (d) Unsolder the two motor contacts.
   (e) Unsolder the S3, S5, and S7 contacts.
7. Carefully slide the MCC out of its holder next to the counter.
8. Gently lift the flex circuit to be certain that all solder connections have been disconnected. If not, use the soldering iron to break the connection.
9. Remove the flex circuit from the camera.
10. Remove the MCC holder from the MCC and retain the holder.

Installation

(Refer to "Flex Circuit I.D. Chart" in paragraph F, Shutter Assembly.)

1. Before the flex circuit can be installed on the camera, a new MCC must first be installed on the flex circuit. Do this as follows:
   (a) Referring to Figure 4-89, position the MCC on the circuit.

   NOTE: Because of the restricted space in which the MCC is mounted, it is imperative that no sharp projections (cut wire ends for example) are left at the MCC solder points. It is also important that the size of the soldered connections be kept to the minimum. To satisfy these requirements, the following soldering procedures must be strictly adhered to.

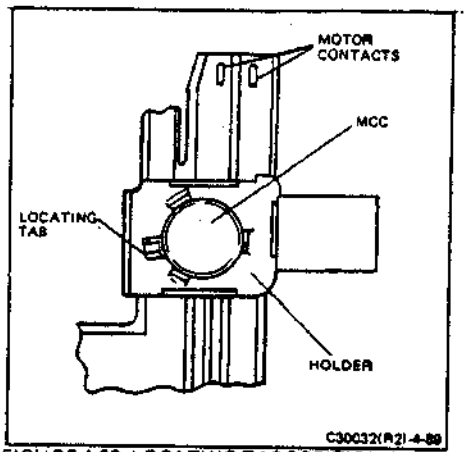


FIGURE 4-89 LOCATING TAB POSITION ON MCC

   (b) Place the flex circuit on the workbench with the MCC on the underside.
   (c) Apply a tweezers to the flex circuit in such a manner that the tips just span one of the MCC solder pads.
   (d) Press lightly on the tweezer tips and apply just enough solder to cover the sharp end of the MCC lead and provide a smooth, rounded surface.
   (e) In like manner, solder the remaining MCC leads.
   (f) Trim the leads using a miniature diagonal cutter. Hold the MCC tightly against the flex circuit, with the cutter jaws flat against the foil surface. Cut an MCC lead at that distance from the surface.
   (g) Cut the remaining leads in the same manner.
2. Position the new flex circuit onto the camera, using the two battery contacts as locating points.
3. Spread the points of tweezers in such a manner that the points will span one of the battery contacts. Press down on the flex circuit until the contact protrudes through the flex circuit and the circuit lies flat.
4. In the same manner, press the flex circuit onto the second battery contact.
5. Solder the flex circuit to both battery contacts.
6. Refer to Figure 4-89 and press the MCC holder into place on the MCC.
7. Slide the MCC holder into its clip at the side of the counter assembly.

   NOTE: In the remaining steps, refer to Figure 4-88 for the location of contacts mentioned.
8. Locate the flex-circuit extension that reaches the two motor contacts. Using tweezers, press the flex circuit over the motor contacts until the contacts protrude through the flex circuit. If this step is performed correctly, the flex circuit will be held securely in place on the two motor contacts.
9. Solder the two motor contacts.
10. Using tweezers, fold back the extension tab of the flex circuit so that it can be pressed into place between the MCC soldered connections and the motor frame.
11. Using tweezers and pressing lightly with your fingers, bend the flex circuit so that it meets the three contacts at S8 and S9 with a small radius bend. (Refer to "Counter" paragraph for information concerning S8/S9 contact configuration or new counters.)
12. Using tweezers, position the flex circuit over the three S8/S9 switch contacts. Span the contacts with the tips of the tweezers (one contact at a time) and press the circuit over the contacts so that each contact protrudes through the solder pads of the flex circuit.
13. Solder the three contacts.
14. Dress the end of the flex circuit tab between the third switch contact and the inner surface of the frame.
15. In the same manner, connect and solder the flex circuit to the two S6 contacts.
16. Carefully form the flex circuit so that it will not make contact with the gears.
17. Connect and solder the flex circuit to the four contacts of switches S3 and S5.
18. In the same manner, connect and solder the flex circuit to the contacts of S7. Form the flex circuit so that it will not make contact with the gears.
19. Prepare a piece of double-faced tape, 1-1/2 by 1/2 inches.
20. Apply the tape ot the camera body at the point where the ribbon cable meets the flex circuit in such a manner that the tape extends 3/4 inch beyond the flex circuit toward the shutter.
21. Fold the flex circuit over the edge of the frame. Make sure that the end of the flex circuit is parallel to the edge of the frame.

22. Press the flex circuit into contact with the tape to secure the flex circuit to the frame.
23. Position the locating pins on the rear of the shutter in the holes on its mounting hinge and install the four retaining screws.
24. Dress the multi-wire ribbon cable in the direction of the flex circuit.
25. Locate the short projecting end of the cable retaining spring and the hole at the base of the cable clamp.
26. Install the spring in the clamp in such a manner that the projection enters the hole in the clamp.
27. Crimp the clamp on the spring with just enough pressure to capture the spring. It does not have to be a tight joint.
28. Solder the cable to the flex circuit. (Refer to "Shutter Assembly" paragraph F, for information concerning different types of shutter cables.)
29. Replace the bottom cover and check camera operation.
30. If operation is satisfactory, install the front cover and submit the camera to full checkout. Then, install the bottom cover leather.

Q. SWITCHES

1. General

There are nine switches involved in the automated functions of the SX-70 camera. (Solid-state switching circuits which are incorporated in the shutter circuit board are not included in this discussion.) Each of the nine switches is subject to failure caused by dirt and corrosion, fatigue and distortion as in any electro/mechanical switching device.

When a camera malfunctions and the cause is isolated to a switch failure, the entire switch is replaced, with one exception. Because the body of S6 is a physical part of the inner frame, only the contacts of the switch may be removed and replaced.

In order to gain access to any of the nine switches, the camera must be partly disassembled. The following steps describe the disassembly and will not be repeated for each of the nine switches.

a. Open the camera and remove the front cover.

b. Peel the leather from the bottom cover.

c. Remove the bottom as instructed in previous paragraphs.

Caution: The standard method for soldering procedures involves inserting a discarded film pack to protect the film compartment. However, when disconnecting and connecting switches, there must be no power applied. Be sure to use a discarded pack in which the battery is exhausted, or insulate one battery terminal.

Caution: When working on the switches, use only a miniature soldering iron.

2. Switch S1

S1 is the camera exposure button. It is subject to all of the usual malfunctions. An S1 failure can be traced to either a malfunction of the red actuator on the shutter housing or a failure of the S1 block in the shutter. To replace the actuator, refer to paragraph G, "Shutter Components". To replace the S1 block, also refer to "Shutter Components".

3. Switch S2

Switch S2 is a part of the Flash Fire Assembly (FFA). The contacts of S2 are actuated by the insertion of a flashbar into the FFA socket. Thus, the camera circuitry is automatically converted to the flash mode of operations. S2 is subject to failure by dirt corrosion, wear, or abuse. If the switch is found to defective, replace the FFA according to procedures found in paragraph G, "Switch Components".

4. Switch S3

Switch S3 actuates the electronic circuitry which, in turn, provides the delay between the Fresnel carrier travel and the exposure to eliminate the effects of mirror (Fresnel) bounce. The switch is mounted in the gear-train assembly and is actuated by the ram. However, the switch can be removed and replaced without removing the gear train assembly (outer plate) from the camera. Proceed as follows:

NOTE: If the camera has a Fairchild shutter, install a .047 to .1 MF polarized capacitor to suppress electrical noise from a switch S3 contact bounce. If the subject camera is so equipped, no further action is required. If not, connect the positive lead of the capacitor to the positive S3 contact and the negative lead to the negative contact of the S5 switch. See Figure 4-90.

Removal

a. Using the miniature soldering iron, unsolder and disconnect the tab of the flex circuit from the S3 contacts.

b. Fold the tab of the flex circuit (do not crease) away from the switch contacts.

c. Refer to Figure 4-90. Remove the S3 adjusting screw. Note that a tab on the switch body rides in a slot to prevent S3 from rotating.

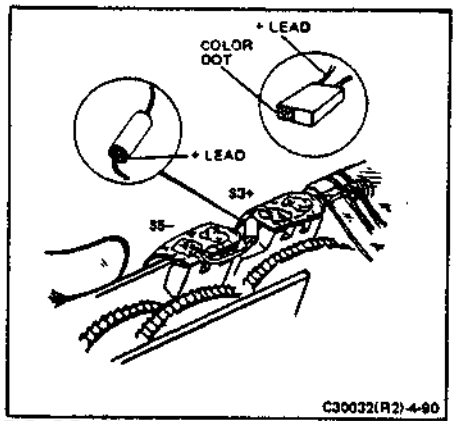


FIGURE 4-90 FAIRCHILD SHUTTER CAPACITOR INSTALLATION (TWO CAPACITOR TYPES)

d. Using either tweezers or needle-nose pliers, grasp one of the switch contacts as close as possible to the body of the switch.

e. Insert the blade of a jeweler's screwdriver between the outer plate and the switch body. Pry the switch body away from the outer plate just enough to let the tab of the switch clear the slot in the outer plate.

f. Remove the switch.

Installation

a. To install the replacement switch, refer to Figure 4-91. Insert the switch in such a position that the arm of the contacts will be as shown on the illustration.

b. Use the jeweler's screwdriver to separate the switch body from the outer plate and provide clearance for the tab.

c. Slide the switch into position until the tab enters the slot in the outer plate.

d. Insert and tighten the S3 adjusting screw.

e. Check S3 adjustment according to the S3/S5 Adjustment procedure immediately following Removal and Installation procedure for switch S5.

5. Switch S4

Switch S4 is an integral component of the shutter assembly. It is actuated by a pin on the plunger of Solenoid no. 1. It is subject to the same malfunctions as the other switches. The switch is a part of the Solenoid no. 1 assembly and the entire assembly must be removed in order to replace S4.

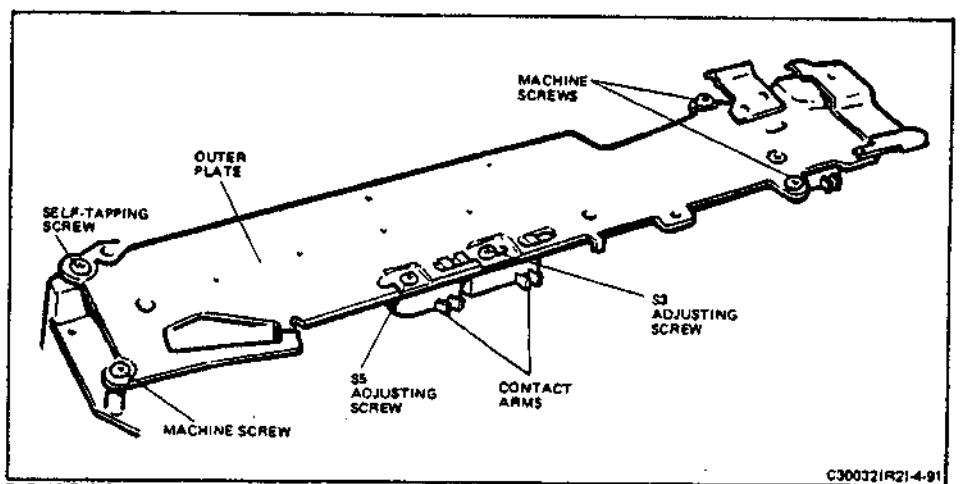


FIGURE 4-91 S3/S5 SWITCHES

To accomplish this, refer to paragraph G, "Shutter Components" for the proper removal and installation methods. After replacing S4, be sure to collimate the camera in addition to performing other camera checks.

6. Switch S5

Switch S5 shuts off power to the drive motor and applies dynamic braking to keep the motor from coasting. Like S3, S5 is mounted in the gear train assembly. Also like S3, S5 can be replaced without disturbing the gear train.

Removal

a. Using the miniature soldering iron, unsolder the tab of the flex circuit from the S5 contacts.

b. Fold the tab of the flex circuit (do not crease) away from the switch contacts.

c. Remove the S5 adjusting screw. Note that a tang on the switch body rides in a slot in the outerplate to prevent S5 from rotating (Figure 4-91).

d. Using either tweezers or needle-nose pliers, grasp one of the switch contacts as close as possible to the body of the switch.

e. Insert the blade of a jeweler's screwdriver between the outer plate and the switch body. Pry the switch body away from the outer plate just enough to let the tab of the switch clear the slot in the outer plate.

f. Remove the switch.

Installation

a. Position the replacement S5 switch so the contact arms are set as shown in Figure 4-91.

b. Use jeweler's screwdriver to separate the switch body from the outer plate and provide clearance for the tab.

c. Slide the switch into position until the tab enters the slot in the outer plate.

d. Insert and tighten the screw.

e. Adjust the switch according to the following procedure.

Repairs/Adjustment

Switches S3 and S5 mounted on the outer plate of the gear train assembly are operated by the recock ram. Correct adjustment of the two switches is vital to proper sequencing of the electrical commands to the substrate. The outer plate is slotted to permit the switches to be moved as necessary. Correct positioning of the two switches is accomplished by use of the S3/S5 adjusting fixture, Special Tool #336073 (Figure 4-92). This procedure must be completed when either S3 or S5 is replaced.

NOTE: In some cases, S3 cannot be properly adjusted because the slot in the outer plate is too short. If, in the following procedure you find you cannot adjust S3 properly, install a new outer plate assembly which already has the new ram. These are:

LCB 705473 – Configuration M
LCB 705696 – Configuration AA
LCB 705673 – Configuration AB

a. On the test set, swing out the handle or the contact assembly.

b. Make sure that both left and right handles are retracted to their limits.

c. Slide the camera (without front cover or bottom plate) onto the horn of the test jig as far as it will go. Engage right and left side fixture handles in the camera.

d. Swing the indicator lamp assembly almost into position.

e. Both indicator lamps should light just before the pins contact the flex circuit pads. This indicates that the power supply is ON. If the camera is in the rest position, the lamps will go out when the pins make contact. Check S3/S5 contact operation – make and break should turn lights off and on.

f. Because of the ratchet action, the hand crank will only rotate in one direction. Rotate the crank and drive the gear train through a complete operating sequence so that the recock ram makes positive contact with S5. If the S5 lamp is still on, loosen the adjusting screw and slide S5 to its forward limit. If the lamp is still on, replace S5 and recheck.

g. If S3 lamp is on, examine the contacts of the indicator lamp assembly to insure that they make good connection with the switch contacts. If the connections are satisfactory but the lamp is still on, replace switch S3, and recheck.

h. When both lamps are off, watch the recock ram and rotate the hand crank. After a few turns, the recock ram should move away from S5. This will allow S5 to open and, as a result, turn on the S5 lamp.

i. Continue rotating the hand crank until the Fresnel carrier snaps to the picture-taking position. At that point in the sequence, the ram makes contact with S3 and opens the switch. The S3 indicator lamp should go on.

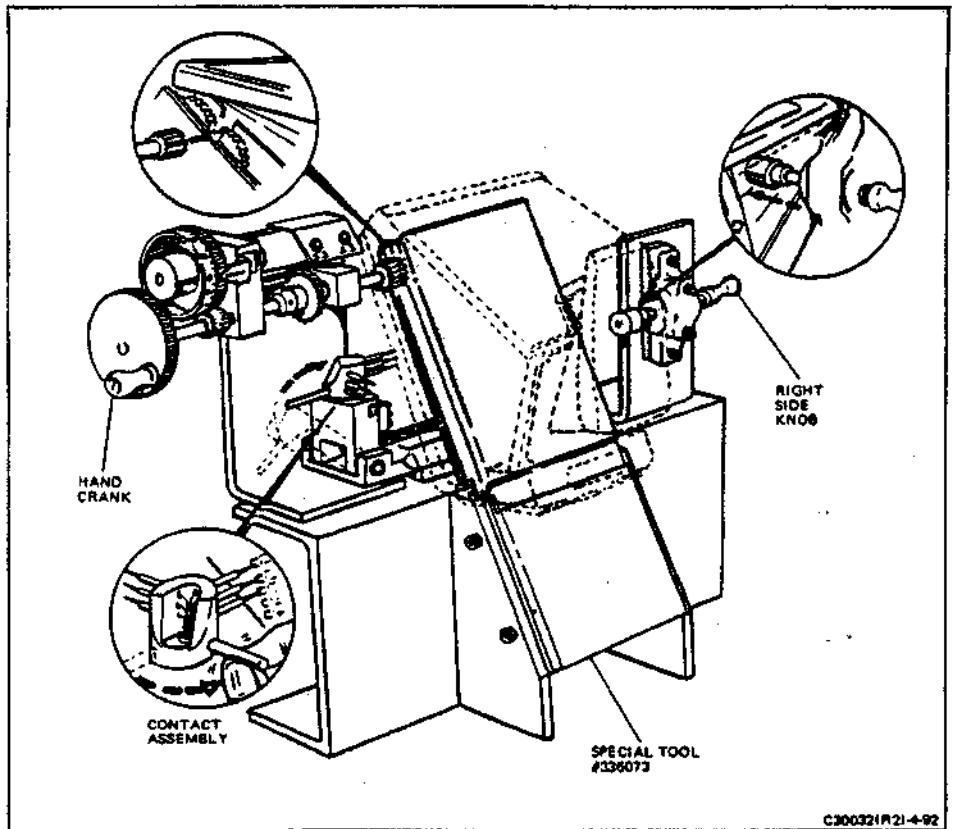


FIGURE 4-92 S3/S5 ADJUSTMENT USING SPECIAL TOOL #336073

j. Release the camera erecting link. Slide the right knob inward so that the bottom edge of the mirror cover rests on the mirror cover stop on the end of the shaft.

k. While observing the S3 indicator lamp, move the mirror cover from the stop to the point just before the erecting link snaps in place. The lamp should go on and off with each up and down motion. This action swings the Fresnel carrier through the angle at which switch action must occur.

l. If the lamp remains off, adjust S3 by loosening the adjusting screw and sliding the switch toward the rear of the camera. Recheck and readjust as necessary.

m. If the lamp remains on, adjust S3 toward the front of the camera. Recheck and readjust as necessary.

NOTE: During the S3 adjustments, the S5 indicator lamp should remain off.

n. When S3 has been correctly adjusted, retract the stop and lock the erecting link.

o. Rotate the crank, driving the gear train through a complete cycle observing pick action, S5 make (light off), and S5 break (light on). Return the gear train to its starting position (recock ram making positive contact with S5).

p. Start the operating sequence again by turning the crank. When the S5 light goes off, stop cranking. Set circular counter to zero.

q. While resuming the slow crank rotation, note the number on the counter from S5 light off to S5 light on. The number shall be between 51 and 69. If the number is less than 51, move the S5 switch towards the front. If it is more than 69, move the S5 switch to the rear of the camera. Adjust and recheck as necessary.

r. Return the camera to its starting sequence (pick return) and remove the camera from the tester.

7. Switch S6

Switch S6 performs an interlock function. It disconnects the battery from the camera circuitry when the camera is closed. Like any other electrical switch, the contacts of switch S6 are subject to the accumulation of dirt and corrosion. Over a period of use, the contacts become subject to fatigue and breakage. In addition, a contact that has become loose on the housing can cause camera malfunctions of both intermittent and continuous nature. If any of the aforementioned causes result in a camera malfunction, the contacts must be either tightened on their mount or replaced. The following paragraphs describe the removal and replacement procedures for the switch. For removal/installation of the S6 actuator, see paragraph C of this section.

Removal

a. Unsolder and disconnect the two S6 contacts (Figure 4-93) from the flex circuit. (These contacts are also identified in Figure 4-88.)

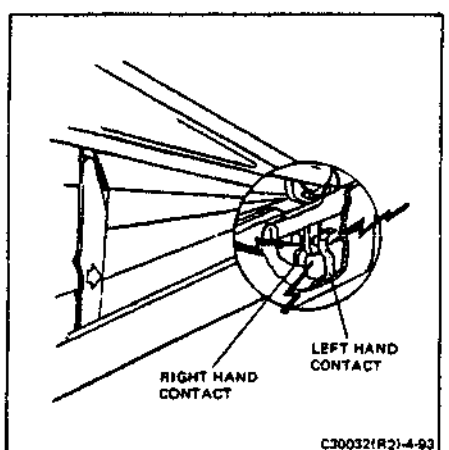


FIGURE 4-93 SWITCH S6 DETAILS

b. Fold back but do not crease the two S6 contacts of the flex circuit.

c. Use a sharp Xacto knife. Shave off the top of the two plastic studs which secure one of the contacts. Lift off and discard the contact.

Installation

Be sure you have the correct replacement contact. The contacts are designated R.H. and L.H. The contact nearest the edge of the camera is the L.H. contact.

a. Position the new contact over the remaining portion of the two retaining studs. Use tweezers or other suitable tool and press the contact down firmly on the studs. The top surface of the studs should be flush with the surface of the contact.

b. Use a sharp scratch awl or any suitable sharp-pointed tool. In the exact center of the plastic stud, make a small locating hole.

c. Use a pin vise with a no. 62 twist drill and drill the contact support boss to a depth of 1/4 inch.

d. Use a pin vise and a 00-96 tap and thread the hole.

e. Install and tighten a 00-96 x 3/32 fillister-head screws.

f. In the same manner, install a screw in the second plastic stud.

g. Replace the other S6 contact in the same manner, if required.

h. Use a V.O.M. on the OHMS X1 scale and check the resistance across the S6 contacts. When the camera is open, S6 should be closed indicating zero ohms. When the camera is closed, the switch should be open indicating infinity.

i. When the switch is functioning correctly, proceed to reassemble the camera.

j. Position the tab of the flex circuit over the S6 contacts. Span one of the contacts with the tips of tweezers and press the circuit over the contacts so that the contact protrudes through the solder pad of the flex circuit.

k. Repeat the procedure for the second contact.

l. Complete the reassembly of the camera.

8. Switch S7

Switch S7 provides the interlock function for the front (film loading) cover. When the cover is open for loading film, battery power is removed from the camera electrical circuits. S7 is subject to all the failure modes associated with the other switches and when it malfunctions it must be removed and replaced. The following steps describe the correct procedure.

Removal

a. Using the miniature soldering iron, unsolder and remove the flex circuit from the S7 contacts.

b. Bend back but do not crease the tab of the flex circuit to provide access to the switch.

c. Remove the S7 retaining screw (Figure 4-94).

d. Loosen the two forward gear-train (outer plate) retaining screws no more than three turns. This is done to permit the stud on the S7 switch body to clear the locating hole in the outer plate (Figure 4-94).

e. Using tweezers, grasp the lower switch contact as close as possible to the body of the switch and lift out the switch.

Installation

a. Using tweezers, slide the replacement switch into position under the outer plate.

b. Install the S7 retaining screw.

c. Tighten the two gear-train (outer plate) retaining screws.

d. Locate the tab of the flex circuit over the two switch contacts.

e. Span one of the contacts with the tips of the tweezers and press the flex down firmly so that the contact protrudes through the solder pad of the flex circuit.

f. Using the miniature soldering iron, solder the two switch contacts.

g. Reassemble and check the camera.

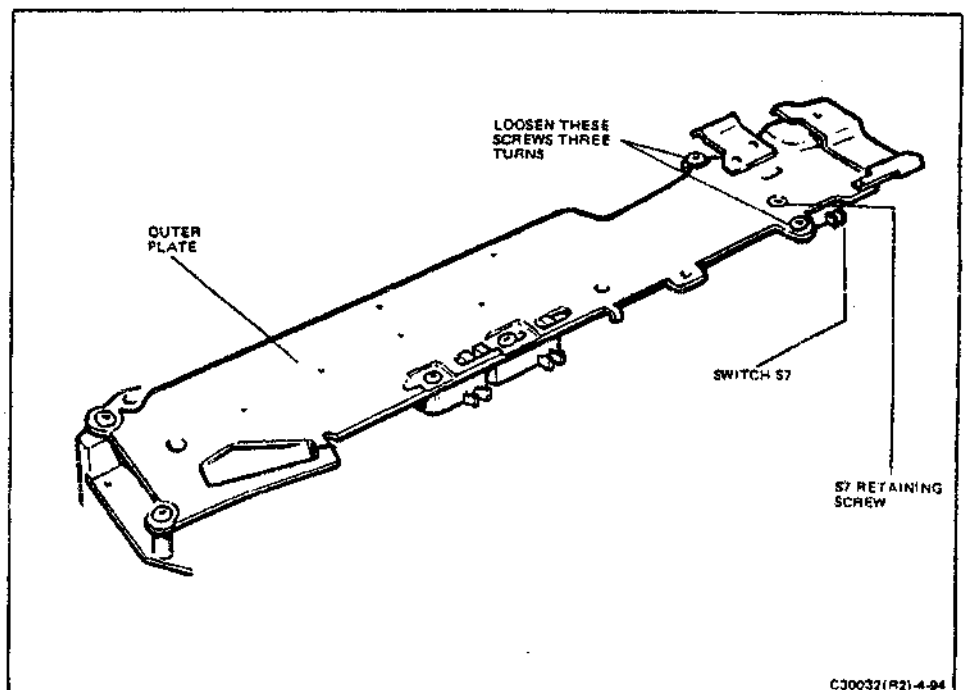


FIGURE 4-94 REMOVING SWITCH S7

Repairs/Adjustments

A history of malfunctioning S7 switches has developed on some cameras. The symptom is undesired flash ignition when the front cover is closed. Closing the front cover causes S7 to bounce. That is, the S7 contacts make, break, and then make again sending pulses to the shutter and causing flash ignition. (The flash generally occurs simultaneously with dark slide ejection.)

If you have a camera that fits this problem, install a plastic cap extension on the front cover actuator post as shown in Figure 4-95. The extension assists in providing a positive closure of S7. In some extreme cases, the switch contacts also require adjustment for a more positive contact. When installing the cap (part number 704617) apply a small amount of Eastman 910 adhesive to the inside of the cap and then slide it down on the actuator post until it is firmly seated. To prevent adhesive spillage on the spread roll drive gear, place a paper shield in position as shown in Figure 4-95.

(Front cover assemblies of Configuration E and later, have a higher actuator post and do not require this change.)

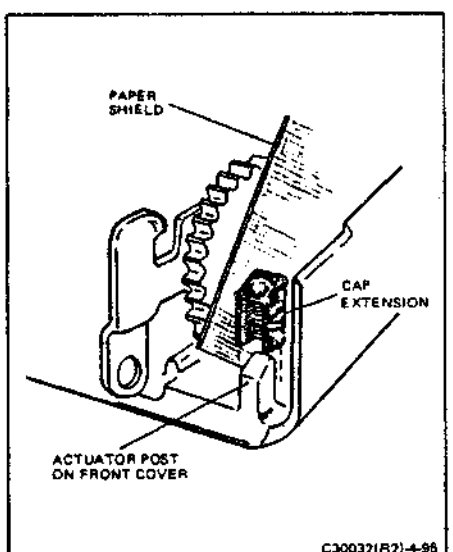


FIGURE 4-95 INSTALLING CAP EXTENSION ON S7 ACTUATOR

9. Switch S8

Switch S8 initiates the dark slide camera cycle when a film pack is inserted and the front cover is closed. It is subject to all of the failures common to other switches in the camera.

Switch S8 is an integral part of the counter assembly. To remove and replace switch S8, refer to the replacement procedures for the counter assembly.

10. Switch S9

Switch S9 notifies the camera circuitry that the counter is on zero and in most cases the film pack has been exhausted. The camera mechanism will still function but the flash circuits are inhibited. It is subject to all of the failures common to the other switches in the camera.

Switch S9 in an integral part of the counter assembly. To remove and replace switch S9, refer to the replacement procedures for the counter assembly.

P. FRONT COVER LATCH

The front cover latch is used to lock the front cover in the closed position. Pressing down on the yellow area of the latch releases the front cover, allowing film to be inserted into the camera. A defective latch may be replaced (without disassembling the entire gear train) as follows:

Removal

1. Open and remove the front cover.
2. Remove the leather from the bottom cover and remove the cover.
3. Remove the gear train cover.
4. Remove the latch pivot screw and the lower standoff screw (Figure 4-96).
5. With a notched jeweler's screwdriver, push the latch spring down, toward the gears, to free it from its clip.
6. Move the latch while observing the manner in which it engages the small S7 actuator cam. You will have to install the new latch in the same way.

   Caution: In the following steps, use care to prevent the gears from disengaging from one another. If the gears do become disengaged, the gear train must be removed, rebuilt and retimed again.

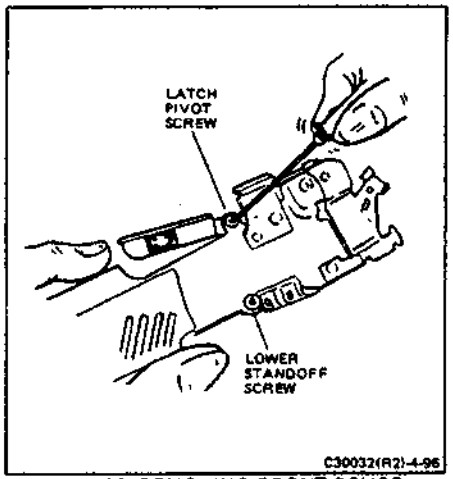


FIGURE 4-96 REMOVING FRONT COVER LATCH

7. Place a thumb under the outer plate at the front of the gear train assembly and push up gently to separate the assembly from the bottom plate.
8. Once the outer plate is separated from the bottom plate, wiggle the spring and latch off the pivot.

Installation

1. Using Figure 4-97 as a guide, install the latch spring on the latch.

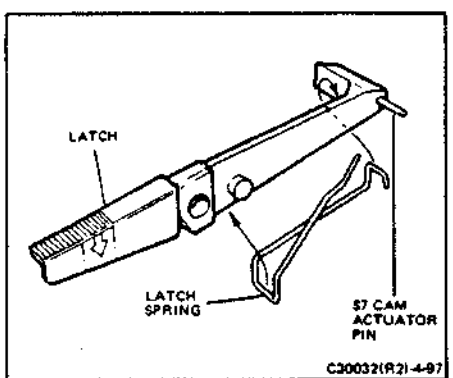


FIGURE 4-97 FRONT COVER LATCH SPRING

2. Identify the S7 cam actuator on the gear train assembly (Figure 4-98). Position the S7 cam actuator pin on the latch into the cam actuator on the gear train.

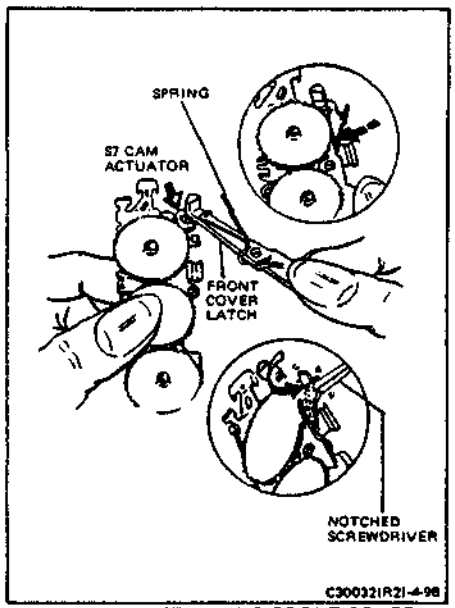


FIGURE 4-98 INSTALLING FRONT COVER LATCH & SPRING

3. Slip the latch over the upper standoff. Insure that the outer plate is flush on the brass standoffs.
4. Using a pick, push the S7 cam actuator to check latch operation. Make certain that the gear pins are tightly secured in their pivot holes.
5. Replace the latch pivot screw and the lower standoff screw (Figure 4-96) to secure the latch.
6. Using a notched screwdriver, position the end of the latch spring under the clip on the outer plate (Figure 4-98).
7. Reassemble and test the camera.

Q. GEAR TRAIN

The gear train assembly provides the motive power for all of the camera automation. Any malfunc-

tion in the gear train will render the camera inoperative. It is possible for a gear tooth (or teeth) to be broken, in which case, proper timing would be lost. Two of the gears are equipped with cam surfaces which are subject to wear although damage to the cams is unlikely. If the recock ram is worn or distorted or if the rivet that secures the ram is loose, the gear train must be removed and replaced.

Testing and fault analysis will indicate a possible malfunction in the gear train assembly. If removal and replacement is indicated, follow the procedures described in the following paragraphs.

Removal

1. Open the camera and remove the front cover.
2. Peel the leather from the bottom cover.
3. Remove the bottom cover, following the instructions given earlier.
4. Remove the gear train cover.
5. Insert an empty film pack, with one battery terminal insulated to prevent electrical continuity. Using a solder remover, remove the solder from switch contacts S3, S5 and S7 (refer to Figure 4-88). In many cases, removing the solder will completely free the flex circuit connections. Use tweezers and a soldering iron, heat the connection and lift off the flex with tweezers. Do not unsolder any other connections at this time. Use a lifting and twisting motion to free contacts from the flex circuit. (On FAIRCHILD shutter installations, observe the capacitor polarity.)
6. Use a pair of needle-nose pliers and open the multi-wire cable clamp sufficiently to release the shutter cable. Unhook the cable retaining spring. (On some cameras, it may be necessary to unsolder the cable. In these cases, refer to paragraph F for instructions.)
7. Use Special Tool #11680 to catch the end of the booster spring. Stretch the spring just enough to unhook the end of the spring from the outer plate (Figure 4-99).
8. Refer to Figure 4-100. Use Special Tool #11680 or tweezers and remove the two override springs.

NOTE: The following step applies to older cameras which have a safety latch.

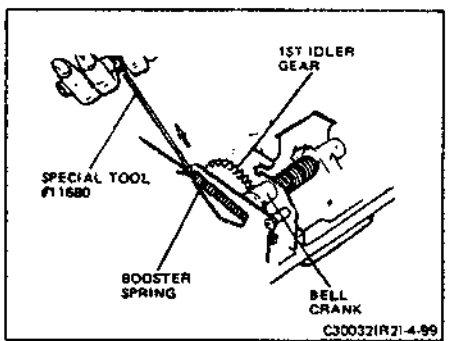


FIGURE 4-99 REMOVING BOOSTER SPRING

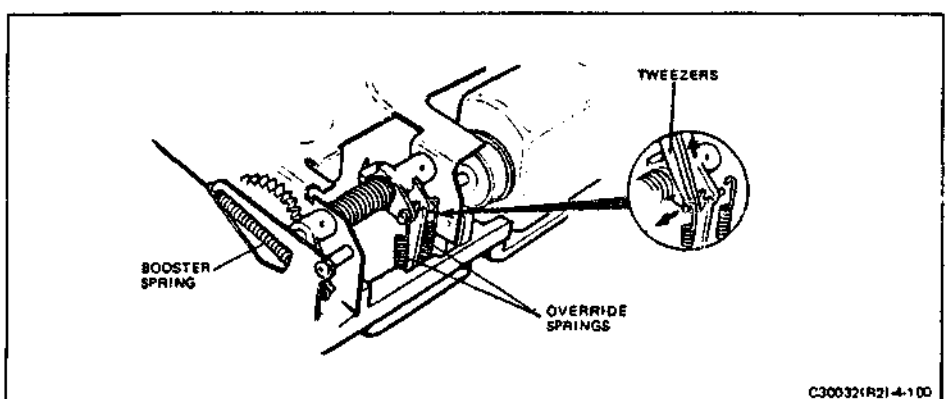


FIGURE 4-100 REMOVING OVERRIDE SPRINGS

9. Using tweezers, unhook the safety latch actuator leg of the single-loop safety latch spring.
10. Refer to Figure 4-101. Use tweezers and slip the hooked end of the Fresnel carrier drive spring off its retainer on the drag link bell crank. Free it from the lug of the overdrive spring.

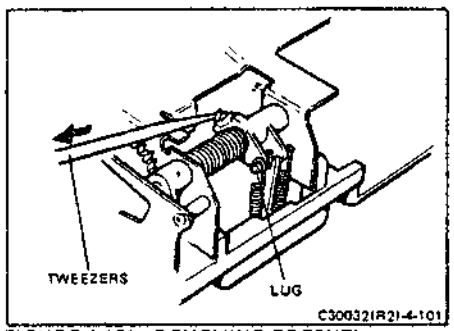


FIGURE 4-101 REMOVING FRESNEL CARRIER DRIVE SPRING

11. Unhook the front cover latch spring.
12. Remove the four outer plate (gear train assembly) mounting screws. (Note that three are machine screws but the fourth is a self-tapping screw. Refer to Figure 4-91.)
13. Invert the camera so that the outer plate (gear train) is on the bottom.

NOTE: If the gear train is being removed for other than gear damage or faulty timing, it may be unnecessary to retime the gear train. For this reason, try not to disturb the gears when performing the following steps.

14. Peel away the flex circuit from the outer plate. Grasp the gear train and pull it down and away from the camera.
15. If the gear train is faulty, remove all the gears.

Installation

Caution: The interrelationship of all gear-train components is critical to correct automation sequencing. Do not deviate from the correct timing procedure.

NOTE: The following procedure applies to newer cameras or early cameras which have been modified with the split-image system. On these cameras, the safety latch is inactive. (For earlier cameras with an operative safety latch, refer to the procedure in the SX-70 Manual dated November 1973.) To remove the safety latch, complete the procedure in "Repairs/Adjustments" at the end of this paragraph.

Figure 4-102 is an exploded view of the gear train.

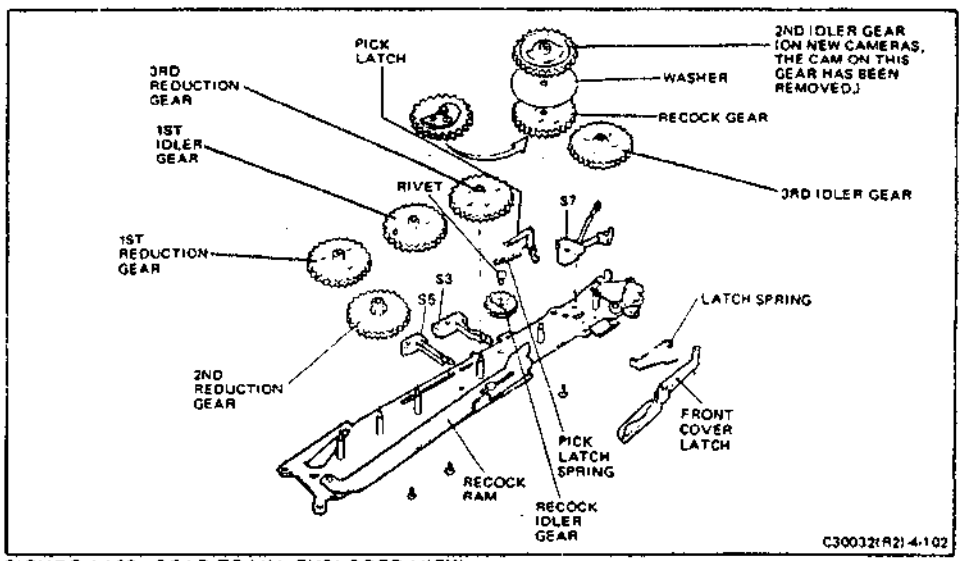


FIGURE 4-102 GEAR TRAIN, EXPLODED VIEW

showing all parts removed from the plate. The purpose of the illustration is to show you the relationship of the parts and to identify the parts which are mentioned in the text below.

Two methods for construction the gear train are acceptable. Use either to properly install and time the gears.

Method A

1. Using a pencil, mark one of the three points of the "Y" mold on the recock idler gear (see Figure 4-103).
2. Install the recock idler gear on the outer plate so the pencil mark is at the two o'clock position (Figure 4-103). (Be sure the gear moves freely after the rivet is installed. Then, set the pencil mark at two o'clock again.)
3. Install the recock gear so the flat surface of the cam under the gear is parallel with the long edge of the outer plate (Figure 4-103). Note that the cam is on the bottom when the cam is installed.
4. Once you are certain the pencil mark on the recock idler gear is at two o'clock and the cam on the recock gear is parallel to the long edge of the outer plate, install the following parts in the precise order given:

   Washer
   2nd Idler Gear } Both over recock gear
   3rd Idler Gear
   2nd Reduction Gear
   1st Reduction Gear
   3rd Reduction Gear

5. Once these parts are installed, again check the pencil mark on the recock idler gear. It must still be at two o'clock to insure that the cam surface on the recock gear is still parallel with the edge of the outer plate.
6. Install the 1st idler gear in such a position that the stud on the gear is at the point where the gear overlaps the 2nd reduction gear (see Figure 4-104). (The first idler gear may be either green or black. Newer gears are black and are fully interchangeable with the green gears.)

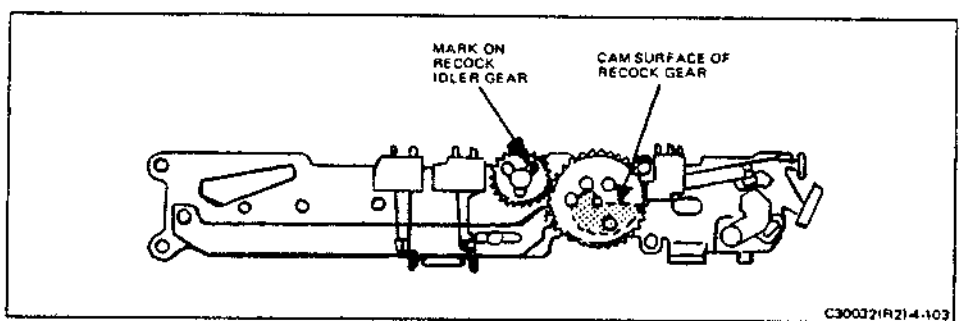


FIGURE 4-103 POSITIONING RECOCK IDLER GEAR AND RECOCK GEAR

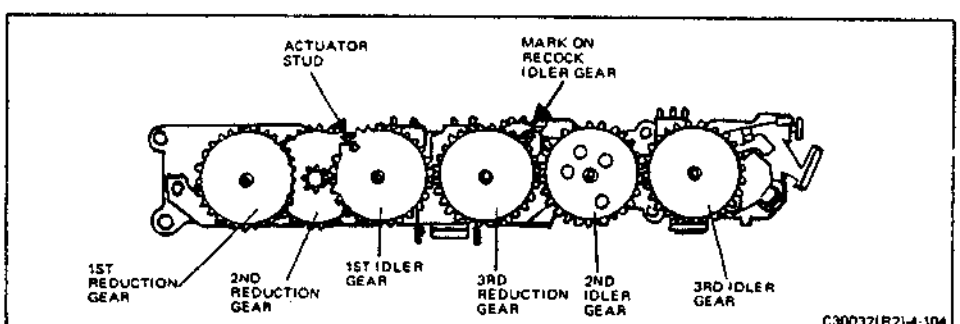


FIGURE 4-104 RELATIONSHIP OF GEARS

7. At this point, install a rubber band lengthwise around the gear train. The gears should be properly positioned and the remaining components (switches, pick latch assembly, and front cover latch) may be installed. While installing these parts, be certain you do not disturb the gear train.

   NOTE: Before completing the following steps, see "Repairs/Adjustments" for information concerning the pick latch.

8. On newer cameras, position the pick latch pivot in the proper hole of the outer plate and hook the longer end of the pick latch spring onto the latch. Using tweezers as shown in Figure 4-105, hook the opposite end of the spring over the retaining lug.

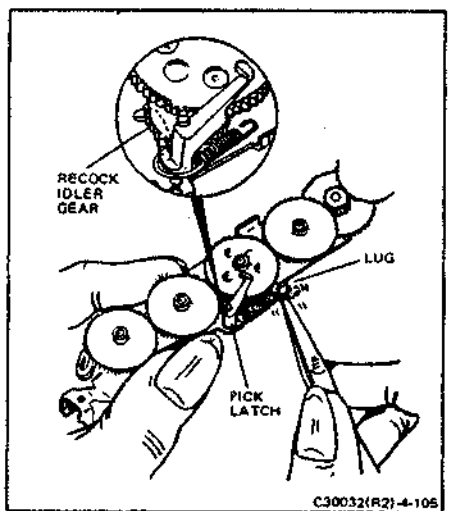


FIGURE 4-105 INSTALLING THE PICK LATCH

9. On early cameras, hook the wide end of the pick latch spring on the pick latch and slide the short hooked end of the latch under the recock gear. (See the inset in Figure 4-105.) Set the latch pivot into the hole on the outer plate and, with tweezers, hook the opposite end of the spring over the retaining lug.
10. Install the gear train on the camera using the retained hardware (three machine screws and one self-tapping screw). Install the screws loosely and remove the rubber band. Then, tighten the screws.
11. Referring to Figure 4-101, connect the Fresnel carrier drive spring to the drag link bell crank.
12. Reconnect the two override springs (Figure 4-100).
13. Reconnect the booster spring (Figure 4-99).
14. Install the shutter cable in the cable clamp. Use needle-nose pliers to close the clamp.
15. Resolder the S3, S5, S7 contacts to the flex circuit.
16. Install the gear train cover.
17. Install the bottom cover and check the camera.
18. Install new leather on the bottom cover.
19. Install the front cover.

Method B

1. Install the 2nd reduction gear on the outer plate.
2. Install the recock gear and rotate it counterclockwise until the flat of the gear's cam surface contacts the recock ram. This will drive the recock ram against the shoulder on the 2nd reduction gear.
3. Install the remaining components in the order given:

   1st Reduction Gear
   Washer
   2nd Idler Gear
   3rd Idler Gear
   3rd Reduction Gear

4. Check to be sure that the recock cam is firm against the recock ram.
5. Install the 1st idler gear so the stud on the gear is at the exact point where the gear overlaps the 2nd reduction gear (see Figure 4-104). (The 1st idler gear may be either green or black. Newer gears are black and are fully interchangeable with the green gears.)
6. At this point, the gears should be properly positioned and the remaining components (switches, pick latch assembly, and front cover latch) may be installed. When installing these parts, be certain that you do not disturb the gear train.
7. Complete steps 8 through 19 of Method A to reassemble the camera.

Repairs/Adjustments

1. Changing the 2nd Idler Gear

The addition of the split image system to the SX-70 resulted in the elimination of the safety latch. A corresponding change was made, eliminating the molded latch actuator cam on the 2nd idler gear. If it is necessary to change the 2nd idler gear on a camera which has a safety latch actuator, use a replacement gear with the molded cam. If a replacement gear with the molded cam is not available and a gear without the cam must be used, the safety latch actuator must be removed. Do this as follows:

a. With the gear train separated from the bottom plate, swing the safety latch actuator 180° away from its normal position.

b. Install the gear train (with the new 2nd idler gear) onto the camera in the manner prescribed above.

c. With the gear train securely in place, apply thumb pressure to support the safety latch actuator pivot post for the following step.

d. Bend the latch actuator up about 30° and then back down again. Continue doing this until the actuator snaps off. It will break at the pivot hole. Remove all pieces.

2. Pick Latch Design Change

Design changes have been made to the pick latch and pick latch spring since the introduction of the camera. If it is necessary to change the pick latch, use #705667 rather than the older style (Figure 4-106). The new latch provides clearance between the pick latch and the lower camera back. This clearance improves operation reliability even under tolerance buildups.

The latch spring has also been improved to prevent overstressing. The new spring is #705668 and can be used only with new pick latch #705667. The earlier spring is #705110 and may be used with both pick latches.

3. Recock Idler Gear Changes

Some failures of early recock gears (specifically, the breaking off of the cam surface on the gear) resulted in malfunctions such as continuous gear operation with no pictures, fresnel locked in the taking position, and no movement of the recock gear even though the other gears moved.

To overcome this, a gear was made from a new, stronger material. Early redesigned gears were white while later gears were black.

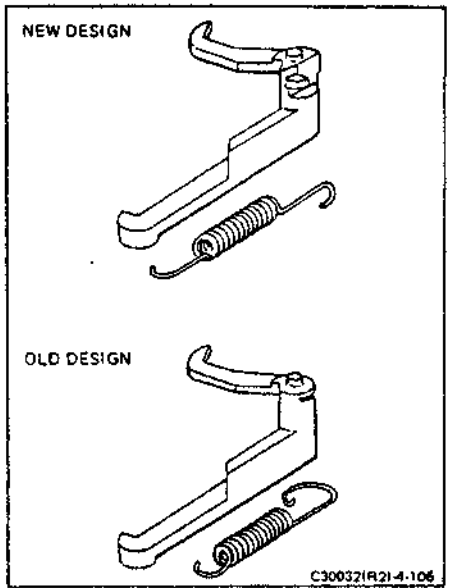


FIGURE 4-106 COMPARISON OF PICK LATCHES AND SPRINGS

If any problems such as those mentioned above are noted, examine the recock gear. If it is faulty, replace it with a new gear (part number 705102). This repair may be made as follows:

a. Strip down the gear train as previously instructed.

b. Trim the staked side of the old recock idler gear stud with a 1/8" drill in a hand-held pin vise and then press out the stud with Special Tool #11735.

c. Install the new gear and stud and stake it in place using Special Tool #11735. The gear must turn freely after the stud is staked.

d. Reassemble the gear train as instructed earlier.

R. PICK STRAP ADJUSTMENT (Necessary only if pick is not contacting film properly)

Pick strap orientation with respect to the gears is critical. The correct position is shown in Figure 4-107.

To view the pick strap as seen in Figure 4-107, remove the front cover and place a light at the opening to the film compartment, then look through the rear of the erecting link slot across

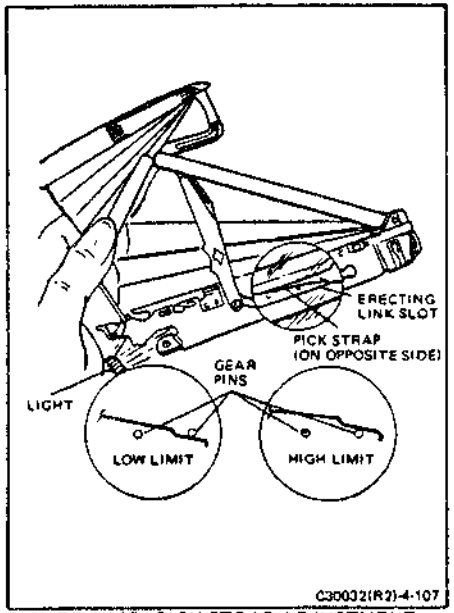


FIGURE 4-107 PICK STRAP ADJUSTMENT

the empty film compartment. If the pick strap does not assume the same position as shown in the drawing, it can be bent into proper shape and orientation by use of Special Tool #11755.

To use, insert the tool through the erecting link slot and catch the strap in the tool slot. Rotate the tool handle to bend the strap either way to its correct position.

S. INNER FRAME BOW ADJUSTMENT

If a complaint relates to incomplete development in the upper corners of the picture, suspect inner frame bowing. To determine whether this problem exists (and the manner in which it may be corrected), complete the following:

1. Remove the front cover and test for bow with the Inner Frame Bow Gauge, Special Tool #11823 (Figure 4-108). Hold the camera with the left hand, insert the gauge and exert pressure on the center of the gauge. The reading should be between +.004 inches and +.011.

2. If the reading is below +.004 inches, use the

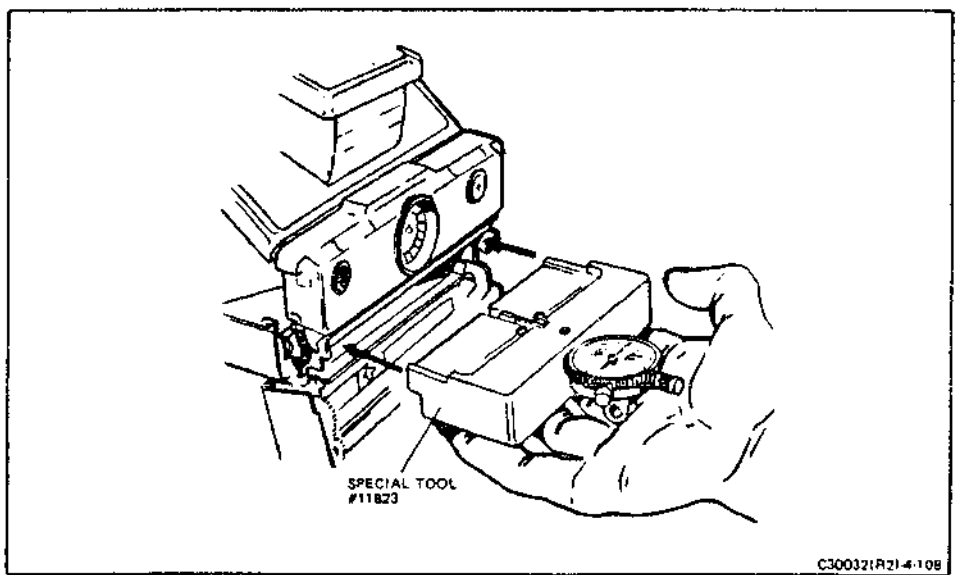


FIGURE 4-108 INNER FRAME BOW GAUGE

Inner Frame Bender. Special Tool #11822 (Figure 4-109). Bend to specifications and retest with Special Tool #11823.

3. If the reading is above +.011 inches, use your thumb or index finger to press against the inner frame to bring the reading within the upper limit. Retest with Special Tool #11823.

4. When the inner frame bow is set according to above, check for flare baffle movement.
   (a) Insert an empty film pack.
   (b) Go through dark slide eject.
   (c) Cover photocell.
   (d) Press S1.
   (e) Remove film pack.
   (f) Examine interior. Flare baffle should not be visible.
   (g) If the baffle can be seen, it is bound and must be repaired or replaced.

NOTE: The two special tools are preset and calibrated at Waltham. The Gauge, #11823, should be checked monthly with a flat metal master and the dial reset if necessary. The Bender, Tool #11822, has a thumbscrew adjustment. Clockwise rotation reduces the amount of bending.

Caution: The camera is more likely to break with counterclockwise screw rotation. Tighten the lock nut and test for correct operation. If the inner frame cracks, do not attempt to repair it. Replace the entire Lower Camera Back.

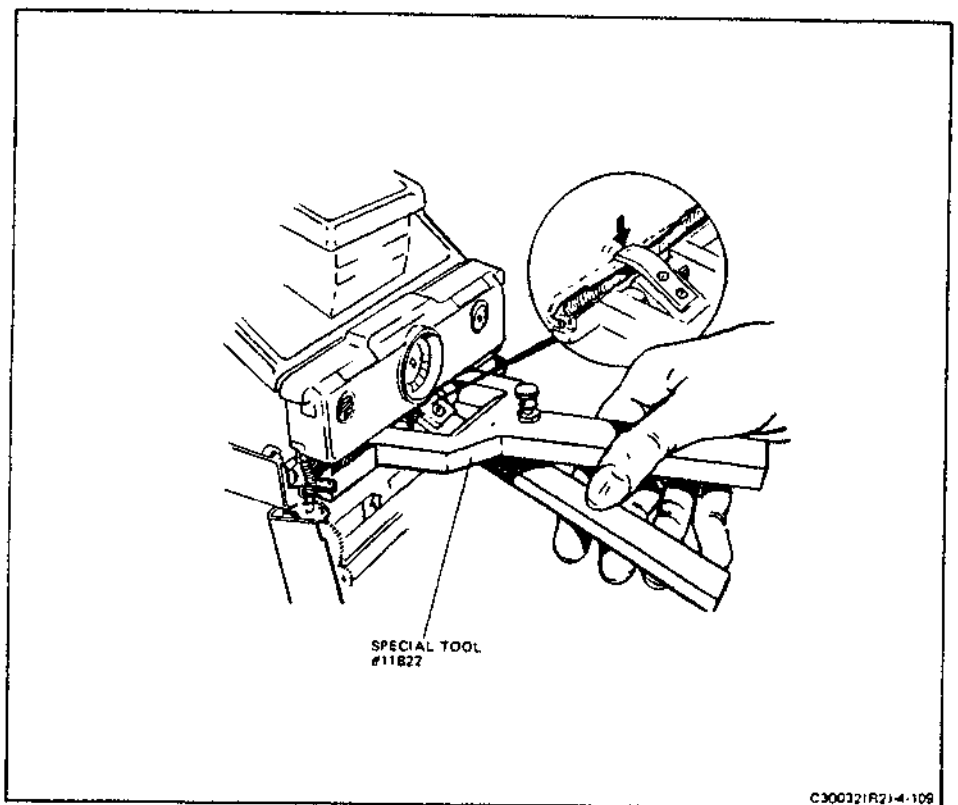


FIGURE 4-109 INNER FRAME BENDER

PARTS CATALOG

INTRODUCTION

When using this parts catalog, be sure to carefully check the information in the Configuration Use and Reference Data column. Note that part usage may be restricted to certain configurations only. Be certain that the part you use fits the configuration you have. Special uses or other pertinent data for particular parts is indicated by repair manual or repair bulletin references.

Quantities listed are the minimum required per assembly. If no quantity is shown, it means a quantity of one is needed.

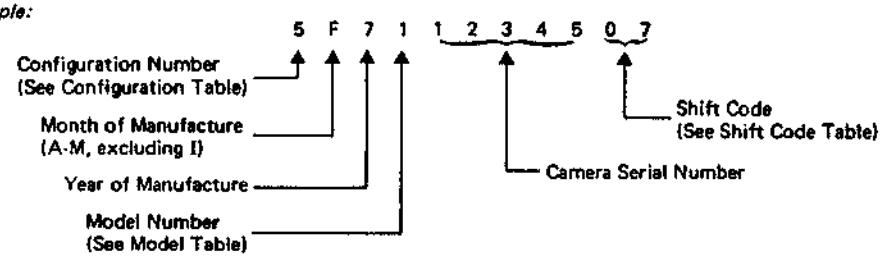
Following is: (1) a listing of abbreviations used in the catalog; (2) an explanation of the manufacturing date code, and (3) a sheet showing the location of configuration markings on various assemblies.

ABBREVIATIONS USED:

BCA	–	Bottom Cover Assembly	MCA	–	Mirror Cover Assembly
BSC	–	Basic Camera Assembly	MTR	–	Motor
CTR	–	Counter	SCA	–	Short Cover Assembly
ECM	–	Electronic Control Module	SFH	–	Shutter Front Housing
F	–	Fairchild	SHB	–	Shutter Hinge Bracket
FCA	–	Front Cover Assembly	TI	–	Texas Instruments
FFA	–	Flash Fire Assembly	VF	–	Viewfinder
LCB	–	Lower Camera Back Assembly			

MANUFACTURING DATE CODE:

Example:

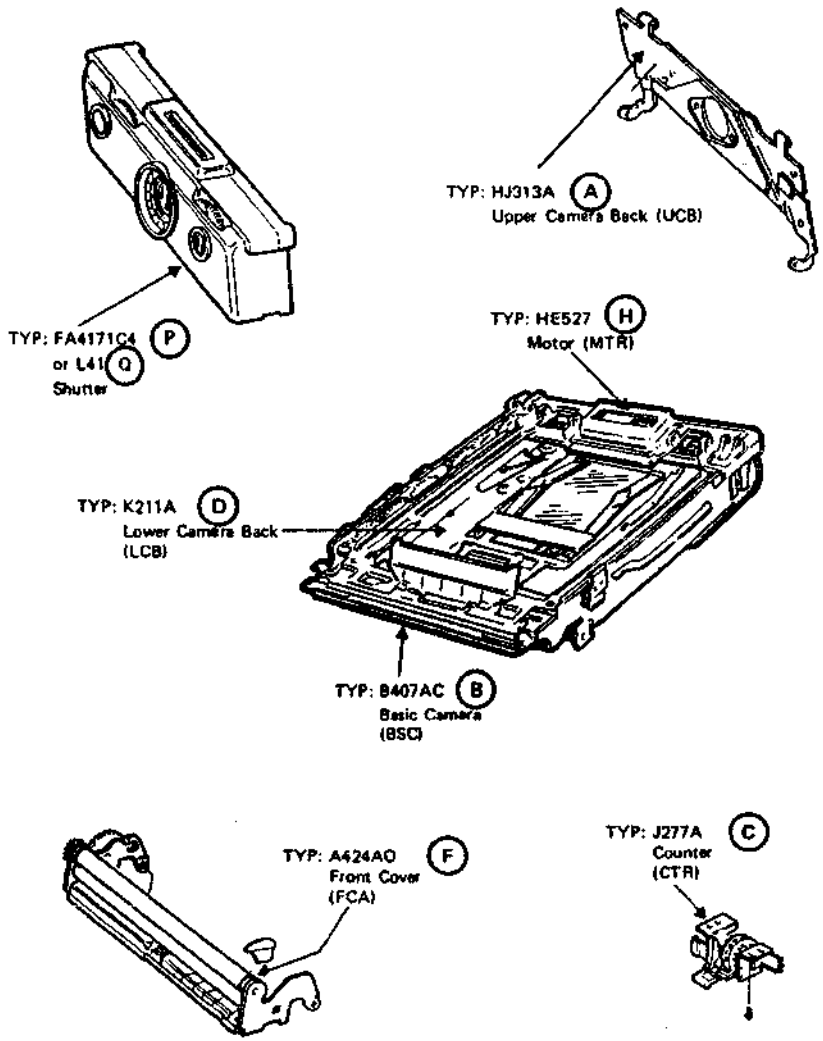


CONFIGURATION TABLE	
NUMBER	**DESCRIPTION**
0	Hybrid Shutter
1	Delta Hybrid Shutter
2	6th Flash Inhibit Shutter
3	Alpha 2 Electronics & Alpha Production Focus Wheel
4	Alpha 2 Electronics & Hybrid Focus Wheel
5	Alpha 2 Electronics & Alpha "K" Focus Wheel
6	Alpha 2 Electronics & ABS Plated Moldings

MODEL TABLE	
NUMBER	**DESCRIPTION**
0 or 1	Model 1 or Alpha 1
2	Model 2, SE, Sears or Alpha 2

SHIFT CODE TABLE		
3 X Date = C-Shift 3 X Date-1 = B-Shift 3 X Date-2 = A-Shift		*Example:* *25 indicates manufacture on A-Shift of 9th day of month.* *3 X 9 = 27 – 2 = 25*

CONFIGURATION LOCATIONS



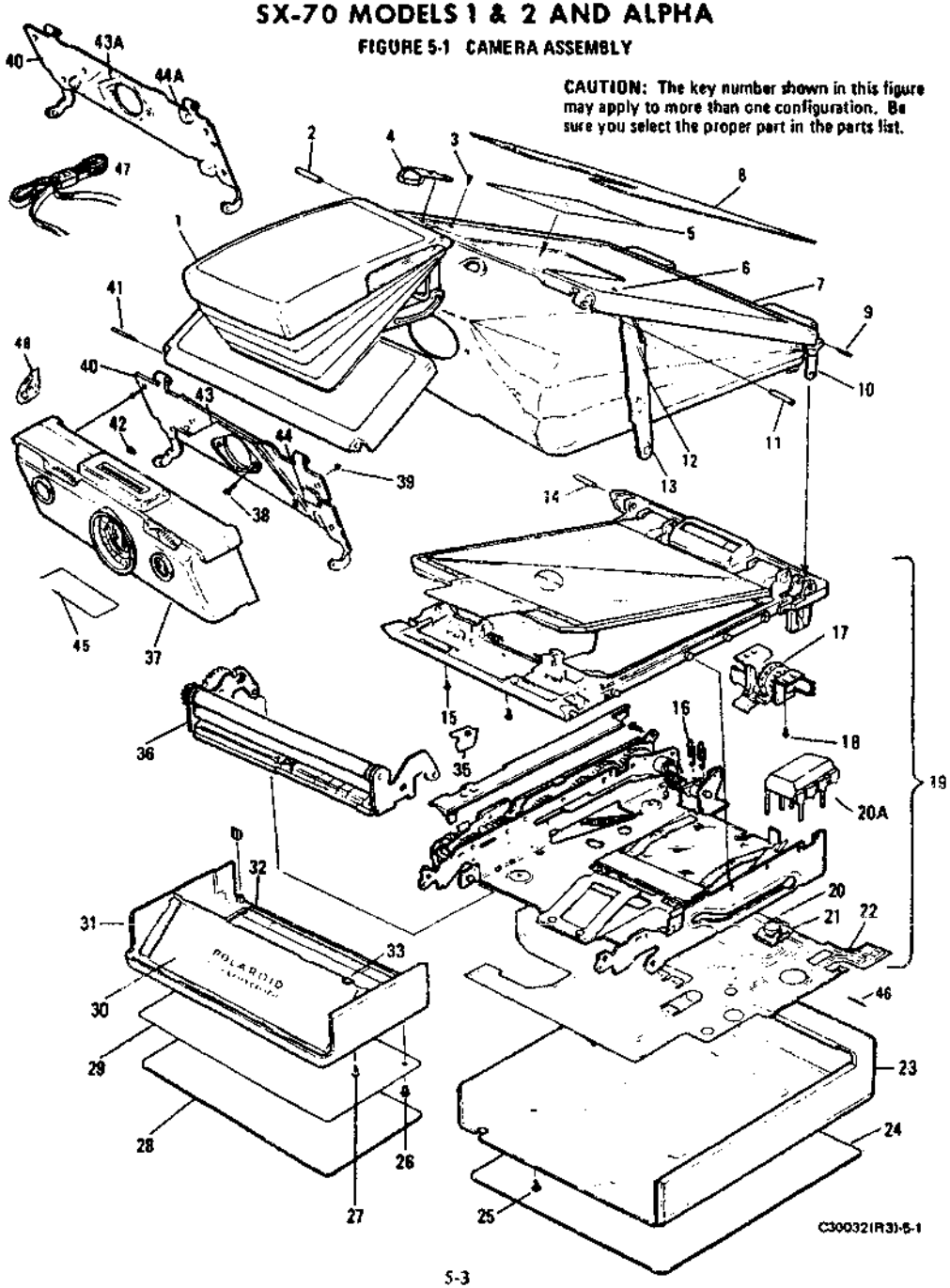
NOTE: 1. The Configuration letter in this illustration is circled.

2. Early cameras have the final camera S/N located on the inner frame. The basic camera S/N on these early cameras is marked in pencil on the shutter hinge bracket.

SX-70 MODELS 1 & 2 AND ALPHA

FIGURE 5-1 CAMERA ASSEMBLY

CAUTION: The key number shown in this figure may apply to more than one configuration. Be sure you select the proper part in the parts list.



SX-70 MODELS 1 & 2 AND ALPHA

PARTS LIST 5-1. CAMERA ASSEMBLY

Key No.	Part No.	Description	Configuration Use and Reference Data
1	–	SHORT COVER ASSEMBLY	Not Stocked: For Chrome Plated Cameras, See Figure 5-3
1	725154	SHORT COVER ASSEMBLY	Ivory Cameras
1	–	SHORT COVER ASSEMBLY	Not Stocked: For Black Cameras, See Figure 5-3
2	705715	Hinge Pin, Left	All (See Prod. Alert #281)
3	705063	Screw, Detent Insert	All – Quantity 2 (See Prod. Alert #281)
4	705831	Detent Insert	All
5	705757C	Decal, Mirror Cover (With red dot)	All except SE models
5	705757D	Decal, Mirror Cover (With blue dot)	SE Models Only
6	705079	Screw, Erecting Link	All – Quantity 2
7	7054468	MIRROR COVER ASSEMBLY	All Chrome Plated Cameras
7	725159	MIRROR COVER ASSEMBLY	Ivory Cameras
7	725291	MIRROR COVER ASSEMBLY	Black Cameras
8	705186	Leather Insert, MCA	Chrome Plated Cameras
8	725145	Porvair Insert, MCA	Ivory and Black International Cameras
8	725145B	Porvair Insert, MCA, Amber	Sears Cameras
8	725145E	Porvair Insert, MCA	Black Cameras (Executive & SE)
8	725145F	Porvair Insert, MCA	K-Mart Cameras
8	725145H	Porvair Insert, MCA, Copra (Tan)	Alpha Sears Special, 1977
9	705033	Cam Pin, Safety Switch	All
10	705199	Actuator, Safety Switch	All
11	705716	Hinge Pin, Right	All
12	705724	Spring, Erecting Link	All
13	705294	Assembly, Erecting Link	All
14	705132	Hinge Pin, Left	All
15	705044	Screw, Inner Frame	All – Quantity 2
16	705902	Override Spring	All – Quantity 2
17	705403	COUNTER ASSEMBLY	A thru E (LCB)
17	705863	COUNTER ASSEMBLY	F thru AN (LCB)
18	705169	Screw, Counter	All – Quantity 2
19	705473	LOWER CAMERA BACK ASSEMBLY	Contains Cable Restrainer (See RIB #241)
19	725290	LOWER CAMERA BACK ASSEMBLY	Contains Cable Restrainer (See RIB #241)
19	725436C	LOWER CAMERA BACK ASSEMBLY (With tripod nut)	All Alpha Cameras
20	705817	Motor Control, T	Use with TI Shutters F thru L
20	705901	Motor Control, T	May be used with all flex circuits. (Refer to RIB #147 & #190.)
20A	705902	Motor Control Module	Use with flex circuit 725120. (Refer to RIB #147 & #190.)
21	705808	Component Holder	Use with all motor controls (MCC).
22	705442	Body Flex, 7 Lead	Refer to Flex Circuit ID Chart, page 4-21 of manual and RIB #190.
22	705329	Body Flex, 8 Lead	Refer to Flex Circuit ID Chart, page 4-21 of manual and RIB #190.
22	725120	Body Flex, 7 Lead	Use with MCM 705882. (See RIB #147 & #190.)
22	725423A	Body Flex	Cameras with motors which have contacts on top. Has clearance for tripod nut.
23	705538E	BOTTOM COVER ASSEMBLY (Includes Counter Window)	Models 1 & 2 Chrome Plated Cameras
23	725158	BOTTOM COVER ASSEMBLY (Includes Counter Window)	Models 1 & 2 Ivory Cameras
23	725295	BOTTOM COVER ASSEMBLY (Includes Counter Window)	Models 1 & 2 Black Cameras
23	725381L	BOTTOM COVER ASSEMBLY (Has counter window, tripod hole, and bright clip pins.)	Ivory Model 2 with neck strap, Sears Alpha Cameras
23	725381K	BOTTOM COVER ASSEMBLY (Has counter window, tripod hole, and bright clip pins.)	Alpha I Cameras
23	725381M	BOTTOM COVER ASSEMBLY (Has counter window, tripod hole, and black clip pins.)	Alpha Executive, Alpha Special Edition, and K-Mart Alpha
24	705188	Leather Insert, BCA	Chrome Plated Cameras
24	725141	Porvair Insert, BCA	Ivory and Black International Cameras
24	725141B	Porvair Insert, BCA, Amber	Sears
24	725141E	Porvair Insert, BCA	Black Cameras (Executive)
24	725141H	Porvair Insert, BCA (With tripod hole)	Ivory Model 2 with neck strap.
24	705188B	Leather Insert, BCA (With tripod hole)	Alpha I Cameras
24	725141K	Porvair Insert, BCA (With tripod hole)	Alpha Executive and Alpha Special Edition Cameras
24	725141M	Porvair Insert, BCA (With tripod hole)	Sears Alpha Cameras
24	725141L	Porvair Insert, BCA (With tripod hole)	K-Mart Alpha Cameras
24	725141N	Porvair Insert, BCA, Copra (Tan) (With tripod hole)	Alpha Sears Special, 1977
24	725141J	Porvair Insert, BCA (With tripod hole)	Alpha Model 2 (See Prod. Alert #268)
25	705021	Screw, Bottom Cover	All – Quantity 4
26	705895	Rivet, Film Catcher Spring	D – G Quantity 4
27	705564	Screw, Spread System	All – Quantity 2
27	705564	Repair Screw, Spread System	All
28	705189	Leather Insert, Front Cover	Chrome Plated Cameras
28	725142	Porvair Insert, Front Cover	Ivory and Black International Cameras
28	725142B	Porvair Insert, Front Cover, Amber	Sears Cameras
28	725142E	Porvair Insert, Front Cover	Black Cameras (Executive)
28	724142F	Porvair Insert, Front Cover	K-Mart Cameras
28	725142J	Porvair Insert, Front Cover, Copra (Tan)	Alpha Sears Special, 1977
29	705361	Film Catcher Spring	B – J
30	725328A	Decal, Light Shield (Repair)	Chrome Plated Cameras
30	725328B	Decal, Light Shield (Repair)	Ivory or Black Cameras
30	725328D	Decal, Light Shield (Repair)	Alpha I Cameras
30	725328E	Decal, Light Shield (Repair)	Alpha Executive Cameras
30	725328F	Decal, Light Shield (Repair)	Sears Alpha and K-Mart Alpha Cameras
30	725482A	Decal, Light Shield (Repair)	Alpha Sears Special, 1977 ("Sears Special" is red)
30	725328G	Decal, Light Shield (Repair)	Alpha Special Edition ("SE" is blue)
30	725328G1	Decal, Light Shield (Repair)	Alpha 1 Special Edition ("SE" is silver)
30	725483A	Decal, Light Shield (Repair)	Alpha Executive ("Executive" is red)
31	7055581H	FRONT COVER ASSEMBLY (Includes Light Shield)	Velour Chrome Plated Cameras
31	7251511	FRONT COVER ASSEMBLY (Includes Light Shield)	Ivory Cameras
31	7252971	FRONT COVER ASSEMBLY (Includes Light Shield)	Black Cameras
32	705758	Decal, Front Cover	All
33	705386	Cam, Light Shield	All (See Prod. Alert #175)
35	725253	Light Seal, Snap-On	See RIB #SX-211
36	705998	SPREAD SYSTEM ASSEMBLY	All
37	726441AM	SHUTTER ASSEMBLY, TI (Has Alpha electronics)	All Cameras (P or higher) (See Prod. Alert #262 for shutter/camera interchangeability)
38	705053	Screw, Shutter Hinge Bracket/Boot	Use with threaded hole boot retainer – Quantity 2
38	705955	Rivet, Shutter Hinge Bracket/Boot	Use with unthreaded hole boot retainer – Quantity 2
39	705056	Screw, Shutter Mounting	Aluminum Base Shutter – Quantity 4
39	700950	Repair Screw, Shutter Mounting	Aluminum Base Shutters
39	705973	Screw, Shutter Mounting	Plastic Base Shutters
40	705597	Shutter Hinge Bracket	All Shutters – No Pivot Pins, No Ribs (Add insulators #43 and 44 as needed) (See Prod. Alert #205)
40	725399	Shutter Hinge Bracket	All Shutters – Ribs, No Pivot Pins (Add insulators #43 and 44 as needed) (See Prod. Alert #205)
41	705717	Hinge Pin, Bracket/Short Cover	All – Quantity 2
42	705639	Rivet (.090"), Shutter Hinge Bracket	All
43	705894	Insulator	All Fairchild Shutters & TI Shutters, P, Q & Later
43A	705743	Insulator	TI Shutters – Configuration F thru L
44	705892	Insulator	All Fairchild Shutters & TI Shutters, P, Q & Later
44A	705744	Insulator	TI Shutters – Configuration F thru L (Quantity 3)
45	725453	Customer Assistance Label	All Cameras (See Prod. Alert #244)
46	725382A	Clip Pins, Bright	Ivory Model 2 with neck strap, Alpha I, Sears Alpha
46	725382B	Clip Pins, Black	Alpha Executive, Alpha Special Edition Cameras, and K-Mart Alpha
47	725457A	LEATHER NECK STRAP ASSY. (With bright clips)	Alpha I Cameras
47	728306C	NARROW NYLON NECK STRAP ASSY. (Black with black clips)	Alpha Executive Cameras
47	728306B	NARROW NYLON NECK STRAP ASSY. (Black with bright clips)	Ivory Model 2 with Neck Strap, Sears Alpha and K-Mart Alpha Cameras
47	725428A	WIDE NYLON NECK STRAP ASSY. (Black with black clips	Alpha Special Edition Cameras
48	725454	Thumb Print Decal	All (See PA #SX-257)

Key No.	Part No.	Description	Configuration Use and Reference Data
26	726035	CAM FOLLOWER ASSEMBLY	N and P
27	706066	Screw, Set #1	F thru M
27	706535	Screw, Set #1	N and P (Aluminum castings)
28	726012	Pull Down Assembly, Sol #2	All
29	706085	Screw, S1 Housing	All
30	706994C	S1 MTG. BLOCK ASSEMBLY	All (See Prod. Alert #277)
31	706087	Screw, Shutter Front Housing	All
31	700904	Repair Screw, Shutter Front Housing (Silver)	All
32	706958	CABLE ASSEMBLY (8 WIRE)	F thru N (without retainer)
32A	706693	Flex, Shutter/Camera Back	See pages 4-19 through 4-26 of manual
33	706097	Screw, Retainer	All
34	706806	Cable Retainer	All
35	726192X	Retainer Filler Plate	Use with Shutter Flex
36	706067	Hex Nut, Sol #2	All
37	706068	Screw, Lens Housing	All – Quantity 4
38	706710	Standoff, Trim Link	All
39	726008	FLASH FIRE ASSEMBLY	TI, P only
39	706367	FLASH FIRE ASSEMBLY	TI, P Aluminum Base Only
39	726130J	FLASH FIRE ASSEMBLY	Models 1 & 2 6th flash inhibit cameras and Alpha cameras
40	735685A	ECM	All (See RIB #SX-283A) Includes a shutter flex.
41	706608	Rivet (FFA)	All
42	-5124	Resistor 15KΩ	As needed for Fairchild shutters
42	-5125	Resistor 27KΩ	As needed for Fairchild shutters
42	-5129	Resistor 2400Ω	As needed for Fairchild shutters
43	912069	Capacitor, 1.0 uf	As needed for Fairchild shutters
44	726374	Insulator, ECM	See Prod. Alert #249

FIGURE 5-2 ALUMINUM BASE SHUTTER ASSEMBLY

CAUTION: The key number shown in this figure may apply to more than one configuration. Be sure you select the proper part in the parts list.

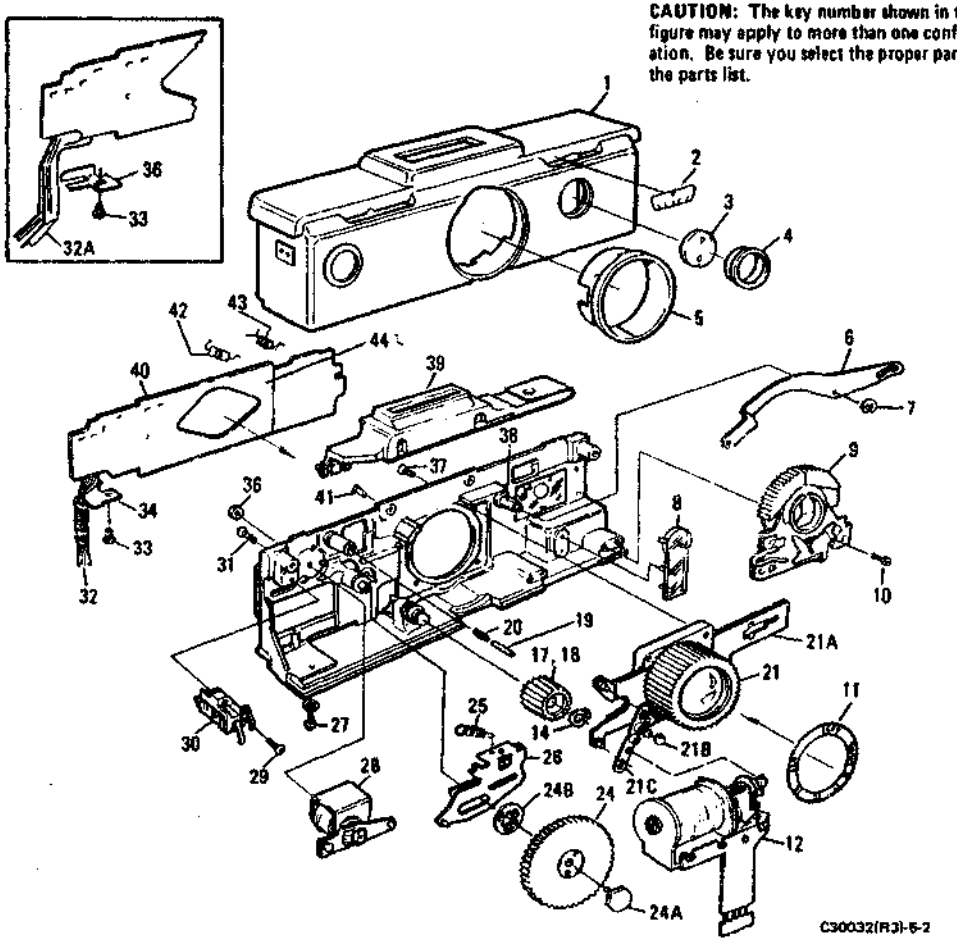
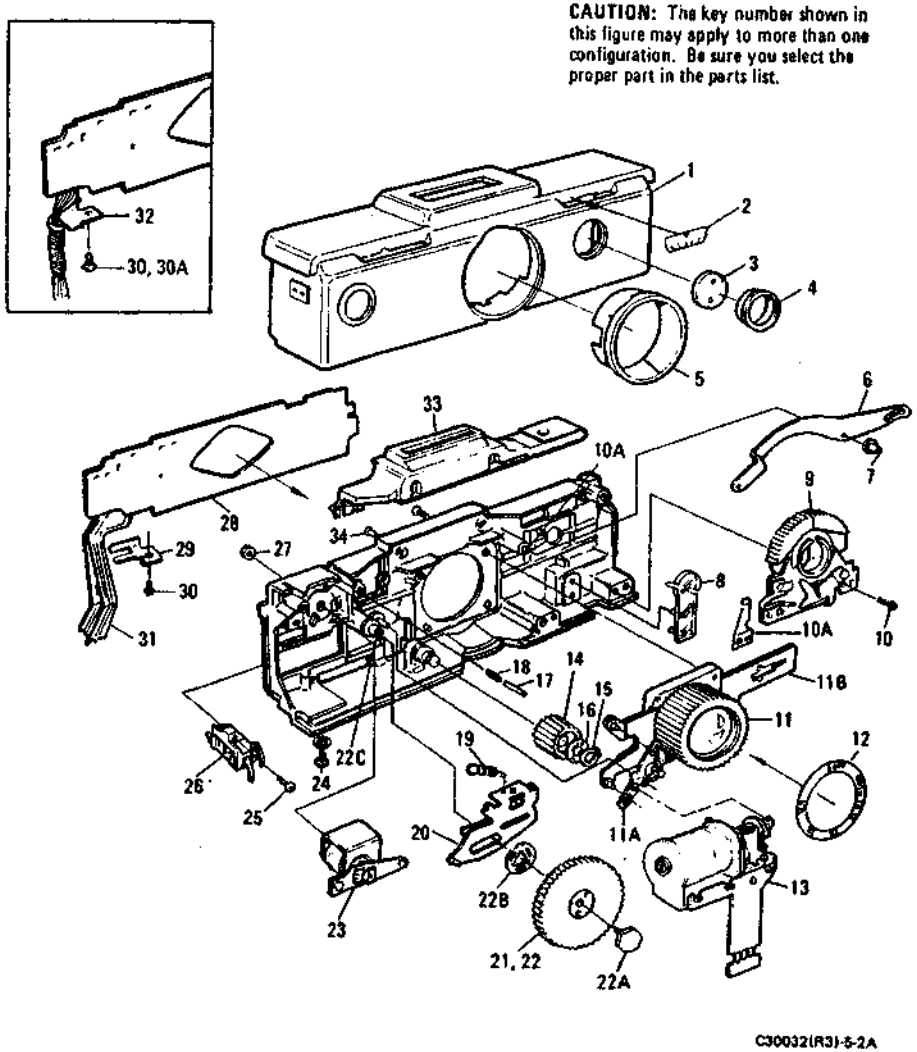


FIGURE 5-2A PLASTIC BASE SHUTTER ASSEMBLY



CAUTION: The key number shown in this figure may apply to more than one configuration. Be sure you select the proper part in the parts list.

C30032(R3)-5-2A

PARTS LIST 5-2A. PLASTIC BASE SHUTTER ASSEMBLY

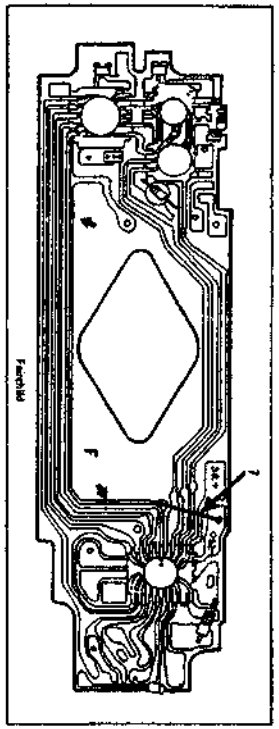
Key No.	Part No.	Description	Configuration Use and Reference Data
1	726076	SHUTTER FRONT HOUSING ASSEMBLY	All Chrome Plated Cameras
1	726165	SHUTTER FRONT HOUSING ASSEMBLY	Ivory Cameras
1	726284	SHUTTER FRONT HOUSING ASSEMBLY	Black Cameras
1	726284N	SHUTTER FRONT HOUSING ASSEMBLY	Special Edition Cameras
2	706788	Trim Decal	Chrome Plated Cameras
2	726268B	Trim Decal	Ivory Cameras
2	726268A	Trim Decal	Black Cameras
3	706657 (GP1 thru 17)	Photocell Window (Blue-Green)	Texas Instruments Shutters (See PA #SX-282)
3	706894 (GP1 thru 17)	Photocell Window (Frosted)	Fairchild Shutters (See PA #SX-282)
3	718456 (A thru T)	Photocell Window	Texas Instrument Shutters (See PA #SX-282)
4	706823	Photocell Bezel (Chrome)	Use on SFH which has chrome bezels
4	726081	Photocell Bezel (Sheet Metal)	Use on SFH which has sheet metal bezels
5	726105	Lens Bezel	All
6	706268	Trim Link	All
7	726315	Grip Ring, Trim Link	P and Q
8	726348	Photocell Lens, Lollypop (Two Legs)	All (See RIB #210)
8	726422	Photocell Lens, V-Groove	All Plastic Baseplate Shutters
9	726135M	TRIM ASSEMBLY (Arrowhead)	Q and higher
10	706668	Screw, Trim Assy., Self-Tap	P, Q and higher – Quantity 2
10	700909	Repair Screw, Trim Assy.	P and Q
10	726071	Trim Link Retainer (Black)	Old trim systems (See RIB #209)
10	726315	Trim Link Retainer (Red)	New trim systems (See RIB #209)
10A	700913	Clip, Blade Hold Down	See RIB #238
11	–	LENS AND BLADE ASSEMBLY	Not Available
11A	726357	Walking Beam	P, Q and higher (See RIB #267)
11B	726070	Shutter Blades, Hybrid	All (See RIB #267) (Blades available only in matched pairs)
12	726109-3	"A" Element Decorative Plate	All
12	726110	"A" Element Decorative Plate	For international use only (metric)
13	706497	Solenoid #1	All Models 1 & 2
13	726111H	Solenoid #1	All Alpha Cameras
14	706656	Idler Gear, Spring-Loaded	P, Q and higher
14	726193	Idler Gear, Spring-Loaded	Replaced 706656 in later configurations (See RIB #203)
14	700907	Repair Idler Gear, Spring-Loaded	Use to Replace 706656 (repairs)
14	701613	Repair Idler Gear, Spring-Loaded	Use to replace 726193 (repairs) (See RIB #203)
15	706093	Retaining Ring, Idler Gear	All gears except 726193 and 701613
15	726073	Retainer, Idler Gear	Use with gears 726193 and 701613 (See RIB #203)
16	726189	Spacer, Idler Gear	For gears 706656 and 700907 only
17	706931	Positive Stop Pin	P, Q and higher
18	706730	Compression Spring	All
19	706937	Extension Spring, Follow Focus	P, Q and higher
20	726035	CAM FOLLOWER ASSEMBLY	N and higher
21	706988	Focus Wheel	P
21	706329	Focus Wheel	N or P
22	726447A	Focus Wheel, Black	For Alpha Cameras
22	726447B	Focus Wheel, White	For Alpha Cameras
22	726053	Focus Wheel (Black)	Q, S, V, X, A, C, D, AB, AC
22	726053B	Focus Wheel (White)	Q, S, V, X, A, C, D, AB, AC
22A	726019	Retaining Screw, Focus Wheel	P, Q and higher
22B	706697	Retaining Ring, Follow Hinge	P, Q and higher
22C	726028	Focus Wheel Pivot	Plastic Baseblock Only
23	726012	PULL DOWN ASSEMBLY, SOL #2	All
24	726063	Screw, Sol #1	P, Q and higher
25	706668	Screw, S1 Housing	P, Q and higher
25	700908	Repair Screw, S1 Housing	P, Q and higher
26	706994C	S1 MTG. BLOCK ASSEMBLY	P, Q and higher (See Prod. Alert #277)
27	706067	Hex Nut, Sol #2	All
28	735685A	ECM	All (See RIB #SX-283A)
29	726182	Retainer/Filter Plate	Use with Flex Cable
30	705169	Screw, Cable Retainer	P and Q
30	700910	Repair Screw, Cable Retainer	P and Q
31	706693	Flex Circuit, Shutter/Camera Back	See pages 4-19 through 4-26 of repair manual
32	706806	Cable Retainer	All (Cable Assembly Shutters)
33	726008	FLASH FIRE ASSEMBLY (FFA)	P
33	726130	FLASH FIRE ASSEMBLY (6th Flash Inhibit)	Models 1 & 2 with 6th flash inhibit feature and all Alpha Cameras
34	706608	Rivet	All – Quantity 2
–	12151	Identifying number "6"	For Delta Hybrid conversions using 6th flash ECM, only.
–	12308	"AM" Shutter Labels	For updates of Q or higher shutters (See RIB #272)

SX-70 MODELS 1 & 2 AND ALPHA

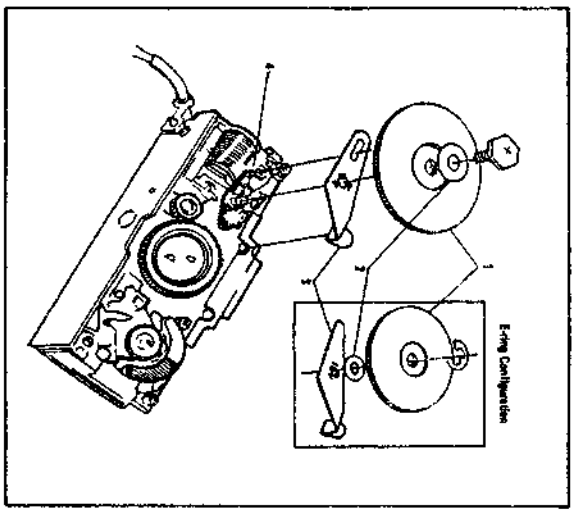
PARTS LIST 5-28. DELTA HYBRID CONVERSION PARTS

(See RIB #207)

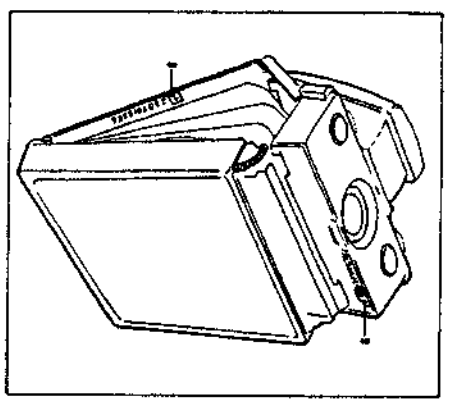
Key No.	Part No.	Description
1	726328A	Focus Wheel A (Small Bore)
1	726328B	Focus Wheel B (Large Bore)
2	12050	Spacer
3	726353A	Follow Focus Guide (Stabilizer) (Small Bore)
3	726353B	Follow Focus Guide (Stabilizer) (Large Bore)
4	726035	Cam Follower Assembly (Yellow Eccentric)
5	12056	Kapton Insulator Tape
6	726318	Diode, IN5317 (For TI "P" Shutters)
7	12057	Jumper Wire, 22-30 AWG, 3/4" long (For Fairchild N or P Shutters)
8	12054	Identifying Number "1"
9	12053	Identifying Letter "W"
9	12055	Identifying Letter "B"

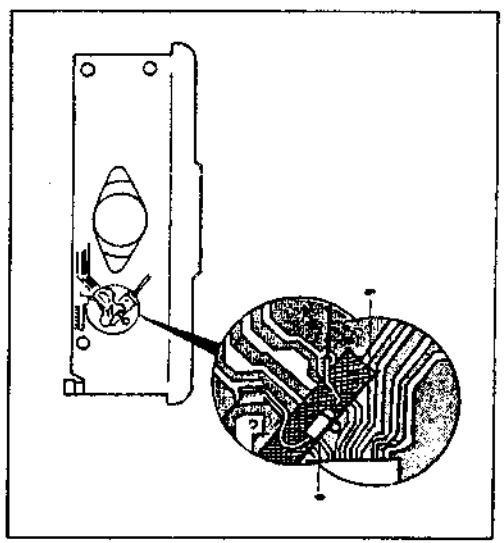


5-10



SX-70 MODELS 1 & 2 AND ALPHA
FIGURE 5-28 DELTA HYBRID CONVERSION PARTS





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SX-70 MODELS 1 & 2 AND ALPHA

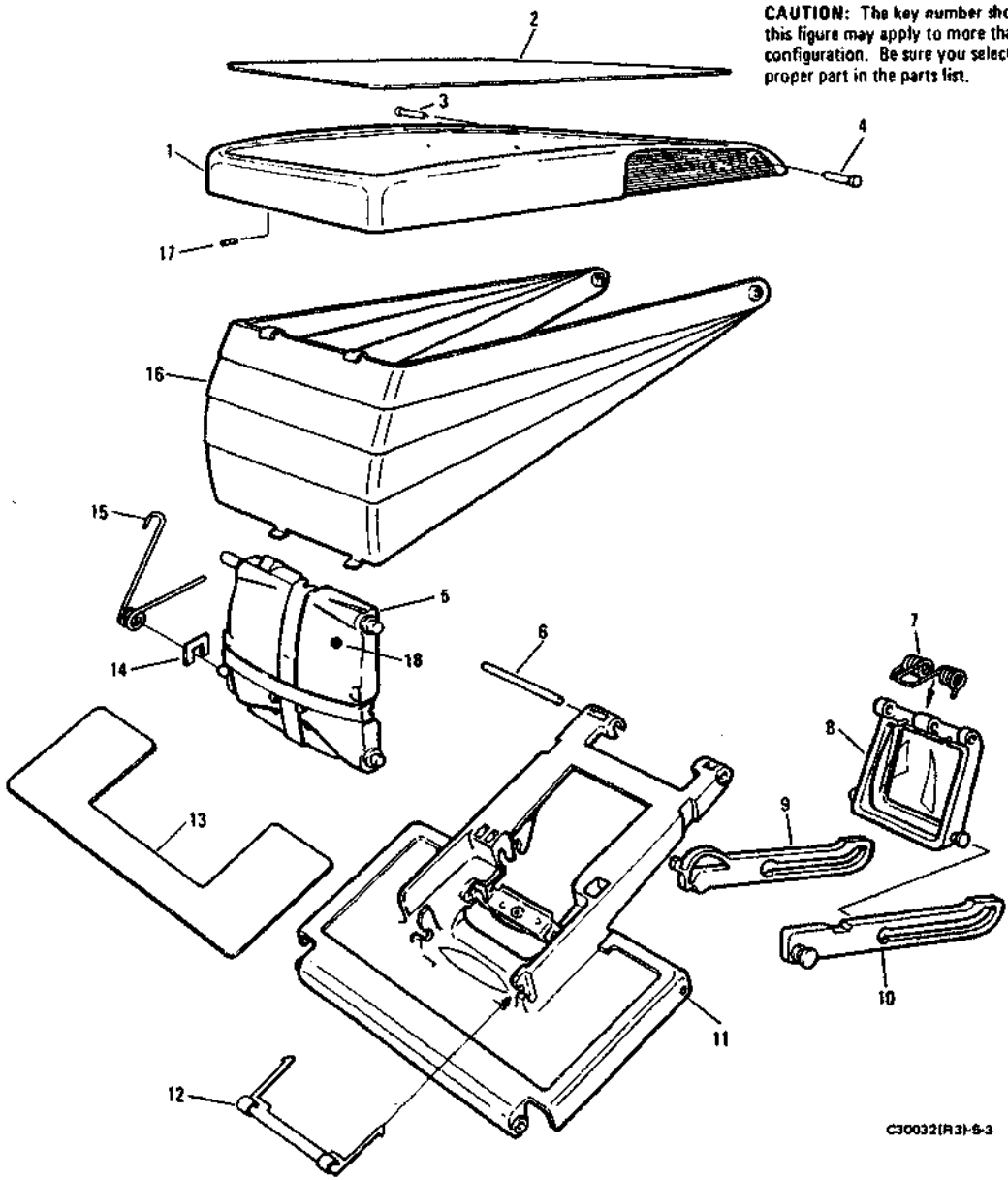
PARTS LIST 5-3. SHORT COVER ASSEMBLY

Key No.	Part No.	Description	Configuration Use and Reference Data
1	705537B	VIEWFINDER CAP ASSEMBLY	All Chrome Plated Cameras
1	725157	VIEWFINDER CAP ASSEMBLY	Ivory Cameras
1	725294	VIEWFINDER CAP ASSEMBLY	Black Cameras
1	705537B	VIEWFINDER CAP ASSEMBLY	Satin Chrome Plated Cameras
2	705899	Leather Insert, V.F. Cap	Chrome Plated Cameras
2	725143	Porvair Insert, V.F. Cap	Ivory and Black International Cameras
2	725143B	Porvair Insert, Amber, V.F. Cap	Sears Cameras
2	725143E	Porvair Insert, V.F. Cap	Black Cameras (Executive)
2	725143H	Porvair Insert, V.F. Cap	K-Mart Cameras
2	725143L	Porvair Insert, V.F. Cap, Copra (Tan)	Alpha Sears Special (1977)
2	725143K	Porvair Insert, V.F. Cap	Alpha Model 2 (See Prod. Alert #268)
3	705848	Pin, R.H., V.F. Cap	Chrome Plated Cameras
3	725147	Pin, R.H., V.F. Cap	Ivory and Black Cameras
4	705849	Pin, L.H., V.F. Cap	Chrome Plated Cameras
4	725148	Pin, L.H., V.F. Cap	Ivory & Black Cameras
5	725063	CONCAVE MIRROR ASSEMBLY	All (Use with spring #725025)
6	705847	Pivot Pin Eyelens	All
7	705299	Eyelens Torsion Spring	All
8	705610	EYELENS ASSEMBLY, 3°	All
9	705245	Eyelens Link, R.H.	All
10	705244	Eyelens Link, L.H.	All
11	725156	SHORT COVER & WAFER ASSEMBLY	Ivory Cameras with SHB 725037/A.
11	725062	SHORT COVER & WAFER ASSEMBLY	Chrome Cameras. Has relief for SHB's 705597 and 725399. (See RIB #242)
11	725156	SHORT COVER & WAFER ASSEMBLY	Ivory Cameras. No relief. Use SHB 705597 only. (See RIB #242)
11	7252928	SHORT COVER & WAFER ASSEMBLY	Black Cameras. Has relief for SHB's 705597 and 725399. (See RIB #242)
12	705389	Positioning Spring	All (Use with mirror #705609)
12	725025	Positioning Spring	All (Use with mirror #725063)
13	705187	Leather Insert, Short Cover	Chrome Plated Cameras
13	725144	Porvair Insert, Short Cover	Ivory and Black International Cameras
13	725144B	Porvair Insert, Amber, Short Cover	Sears Cameras
13	725144E	Porvair Insert, Short Cover	Black Cameras (Executive)
13	725144F	Porvair Insert, Short Cover	K-Mart Cameras
13	725144H	Porvair Insert, Short Cover, Copra (Tan)	Alpha Sears Special (1977)
14	705888 SK1	Shim, Red	.036"
14	705888 SK2	Shim, Blue	.040"
14	725057-1	Shim, Red	All (See Prod. Alert #240)
14	725057-2	Shim, Yellow	All (See Prod. Alert #240)
14	725057-3	Shim, Black	All (See Prod. Alert #240)
14	725057-4	Shim, White	All (See Prod. Alert #240)
15	705287	Concave Mirror Spring	All
16	705938	VF SHADE BLADE ASSEMBLY	All
17	705077	Adjusting Screw	All
18	3469	Blue Dot	For identification of refurbished cameras
18	3468	Orange Dot	For identification of refurbished cameras

SX-70 MODELS 1 & 2 AND ALPHA

FIGURE 5-3 SHORT COVER ASSEMBLY

CAUTION: The key number shown in this figure may apply to more than one configuration. Be sure you select the proper part in the parts list.

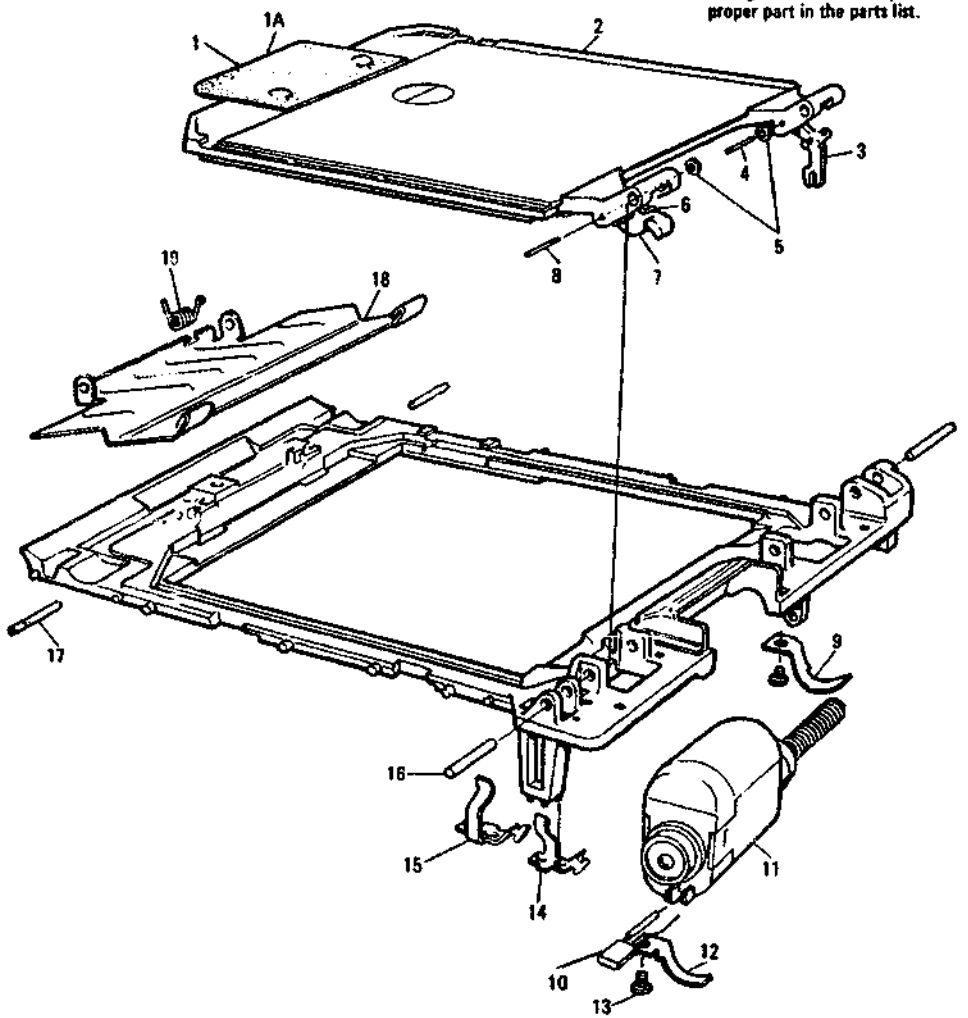


SX-70 MODELS 1 & 2 AND ALPHA
PARTS LIST 5-4. INNER FRAME ASSEMBLY

Key No.	Part No.	Description	Configuration Use and Reference Data
1	705801	Light Stop	All
1A	705832	Tape, Two-Sided	Adhesive for light stop #705801
2	705456D	FRESNEL ASSEMBLY	Split Image
3	705897	Drag Link	All
4	705721	Drag Link Pin	All
5	Not Available	Spacer, Fresnel	All (as required)
6	705124	Drive Pawl Spring	All
7	705223	Drive Pawl	All
8	705123	Drive Pawl Shaft	All
9	705705	Motor Clamp, Right	As needed (replaced by 705388 in later models)
10	705669	Capacitor (.10 uf, 50 vdc)	For mid-cycle shutdown fix. See page 4-25 of Repair Manual
10	705795	Capacitor (.68 uf, 16 vdc)	For mid-cycle shutdown fix. See page 4-25 of Repair Manual
11	725285	MOTOR ASSEMBLY	Long flex coupling and contacts on top.
12	705706	Motor Clamp, Left	As needed (replaced by 705388 in later models)
13	705168	Screw, Bristol (Drive Motor, SS, and Counter Mounting)	All – Quantity 6
13	705956	Screw, Square Drive, Loading Plate	Used with loading plate 705388 – Quantity 2
14	705271	Safety Switch Contact, Right	All
15	705270	Safety Switch Contact, Left	All
16	705134	Hinge Pin, Fresnel	All – Quantity 2
17	705281	Baffle Hinge Pin (Qty. 2)	For LCB 725198 & 705473
17	725097	Baffle Hinge Pin (Qty. 2)	For LCB 725265 (strengthened assembly)
18	705314	Baffle	For LCB 725198 & 705473
18	725128	Baffle	For LCB 725265 (strengthened assembly)
19	705232	Baffle Spring	For LCB 725198 & 705473
19	725090	Baffle Spring	For LCB 725265 (strengthened assembly)

SX-70 MODELS 1 & 2
FIGURE 5-4 INNER FRAME ASSEMBLY

CAUTION: The key number shown in this figure may apply to more than one configuration. Be sure you select the proper part in the parts list.



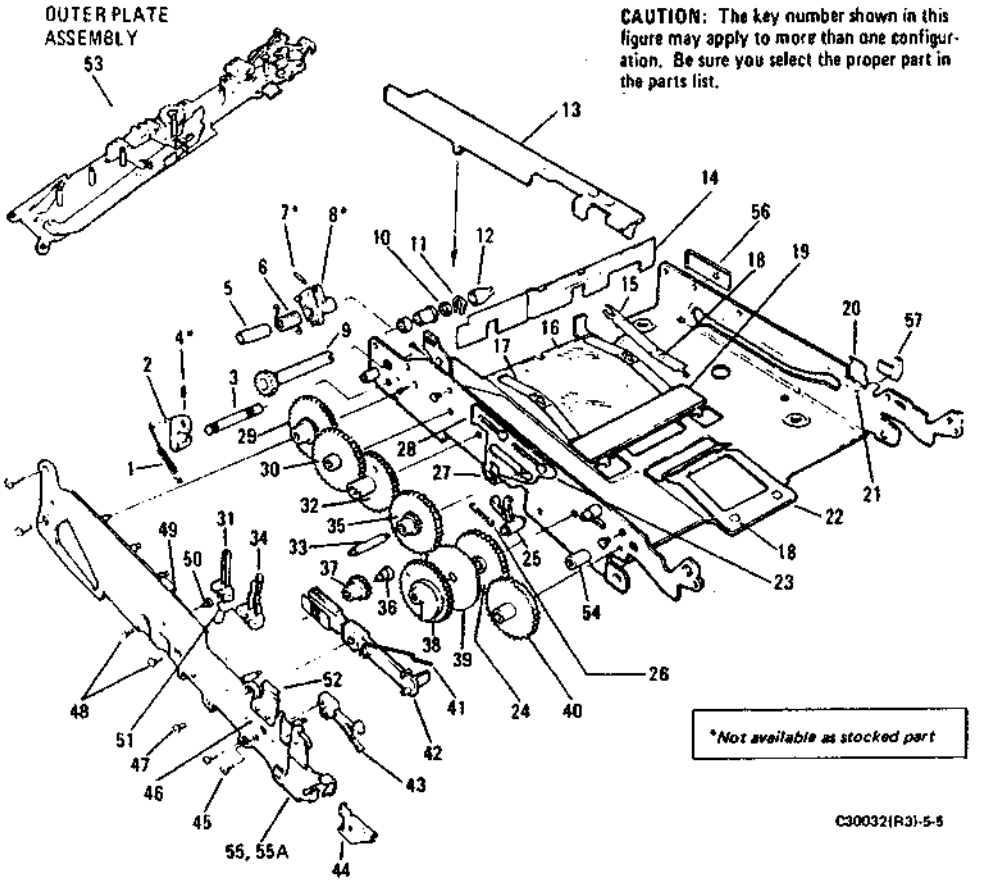
C30032(R3)-5-4

PARTS LIST 5-5 BOTTOM PLATE/OUTER PLATE ASSEMBLY (CONTINUED)

Key No.	Part No.	Description	Configuration Use and Reference Data
7	–	Drive Pin, Bell Crank	Not available (See para. 1, Section 4)
8	–	Drive Link, Bell Crank	Not available (See para. 1, Section 4)
9	705713	MOTOR PINION SHAFT ASSEMBLY	All
10	705036	Washer	All
11	705007	Grip Ring, Motor Shaft	All
12	705871	Coupling Adaptor	All (See RIB #221)
13	705420	Gear Train Cover	All
14	705755	Loading Plate, Decal	Use with motor clamps 705705 & 705706
14	705388	Loading Plate with Clamps	Replaces item 14
15	705224	Reset Pawl Spring	All
16	705274	Contact Insulating Strip	All
17	705272	Battery Contact	All – Quantity 2
18	705003	Rivet (Reset Pawl Spring)	All – Quantity 3
19	705273	Contact Retaining Block	All
20	725178	Detent Clip (.008") (Erecting Link Slide)	All
21	705062	Repair Rivet (Detent)	All – (Replaces pin 705702 for repair)
22	705249	Front Pack Spring	All
23	705125	Pick Slide Pin	All
24	705634	Second Idler Gear	All
25	705667	Pick Latch	All
26	705110	Pick Latch Spring	All
26	705668	Pick Latch Spring	Use only with pick latch 705667
27	705106	Pick Return Spring	All
28	705222	PICK ASSEMBLY	All
29	705203	First Reduction Gear (Black or Green)	All
30	705204	Second Reduction Gear	All
31	705318	S5 ASSEMBLY	All
32	705209	First Idler Gear	All
33	705104	Gear Pin	All – Quantity 6
34	705317	S3 ASSEMBLY	All
35	705205	Third Reduction Gear	All
36	705102	Idler Gear Stud	All
37	705200	Recock Idler Gear (Nylon)	All
38	705842	RECOCK GEAR ASSEMBLY	All
39	705745	Washer	All
40	705206	Third Idler Gear	All
41	705680	Latch Spring	All
42	705679	Latch Assembly (Includes decal 705761)	All
43	705594	S7 ASSEMBLY	All
44	705851	Metal Cable Cover	All
45	725380	Screw, Mounting S7	All
46	705062	Rivet, Outer Plate Detent	All – Quantity 2
47	705044	Screw, Outer Plate/Inner Frame	All – Quantity 3
48	705169	Screw, S3/S5, Bristol Drive/Counter	All – Quantity 3
48	705956	Screw, Self-Tapping, Square Drive S3/S5 Outer Plate and Counter	All – Quantity 5
49	705301	Recock Ram	All
50	705722	Ram Slide Pin	All
51	705799	Capacitor	As required (Fairchild)
52	705830	Detent Clip	All
52	726386	Detent Clip, Notched	All (Replaces 705830)
53	725086	OUTER PLATE ASSEMBLY (less Gears)	Use with Flex Guide
54	705103	Lower Standoff	All
55	705682	Flex Guide	Use with Flex
55A	705280	Cable Restrainer	Use with Wire Cable
56	3485	Light Seal, Boot Tab, Tape	As necessary
57	705566	Spacer, Bottom Cover	As necessary

SX-70 MODELS 1 & 2 AND ALPHA

FIGURE 5-5 BOTTOM PLATE/OUTER PLATE ASSEMBLY


OUTER PLATE ASSEMBLY
53
CAUTION: The key number shown in this figure may apply to more than one configuration. Be sure you select the proper part in the parts list.
*Not available as stocked part
C30032(R3)-5-5

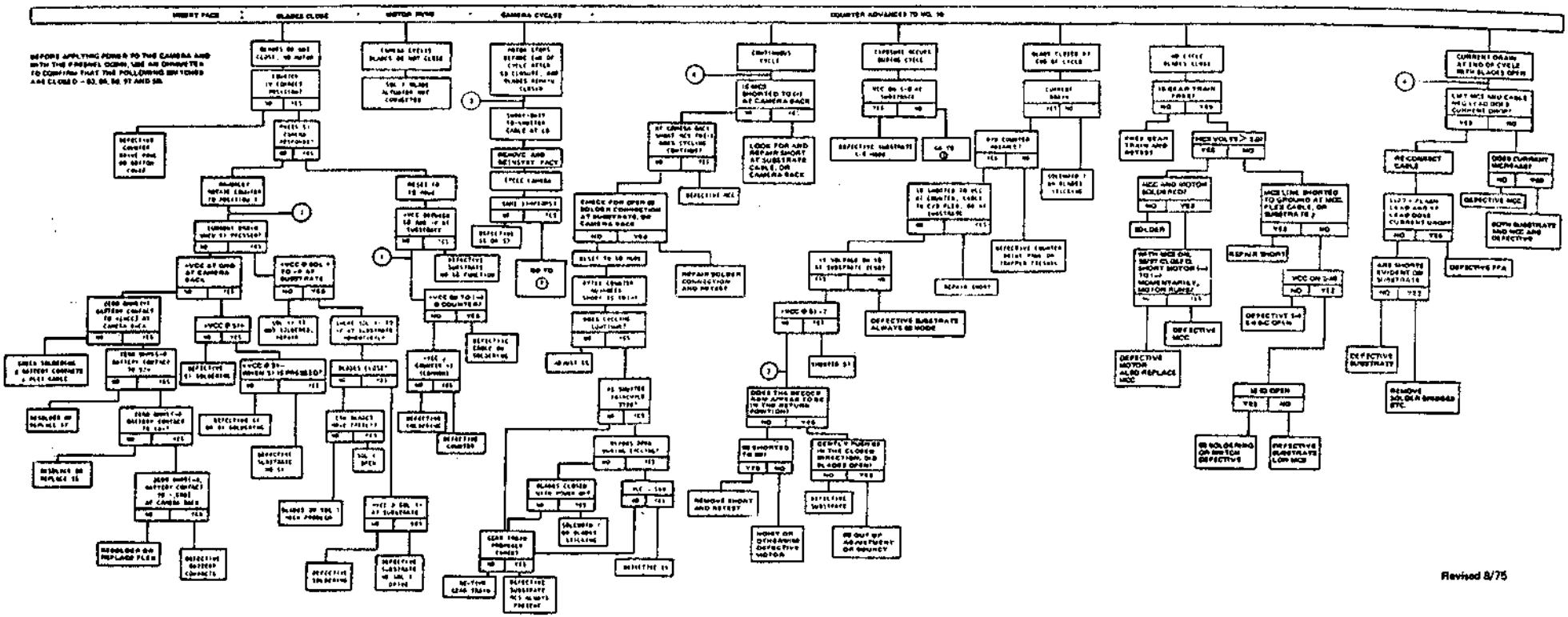
SX-70 MODELS 1 & 2

PARTS LIST 5-5 BOTTOM PLATE/OUTER PLATE ASSEMBLY

Key No.	Part No.	Description	Configuration Use and Reference Data
1	705353	Booster Spring	Use only with round wire drive spring (See RIB #143)
2	–	Bell Crank	Not available (See para. 1, Section 4)
3	–	Recock Drive Shaft	Keyed (See para. 1, Section 4)
4	–	Drive Pin, Bell Crank	Not available (See para. 1, Section 4)
5	–	Sleeve	Not available (See para. 1, Section 4)
6	–	Drive Spring	Use with keyed recock drive shaft. (See para. 1, Section 4)

FAILURE ANALYSIS CHART #1

DARK SLIDE EJECT MODE – S8 (CAMERA)



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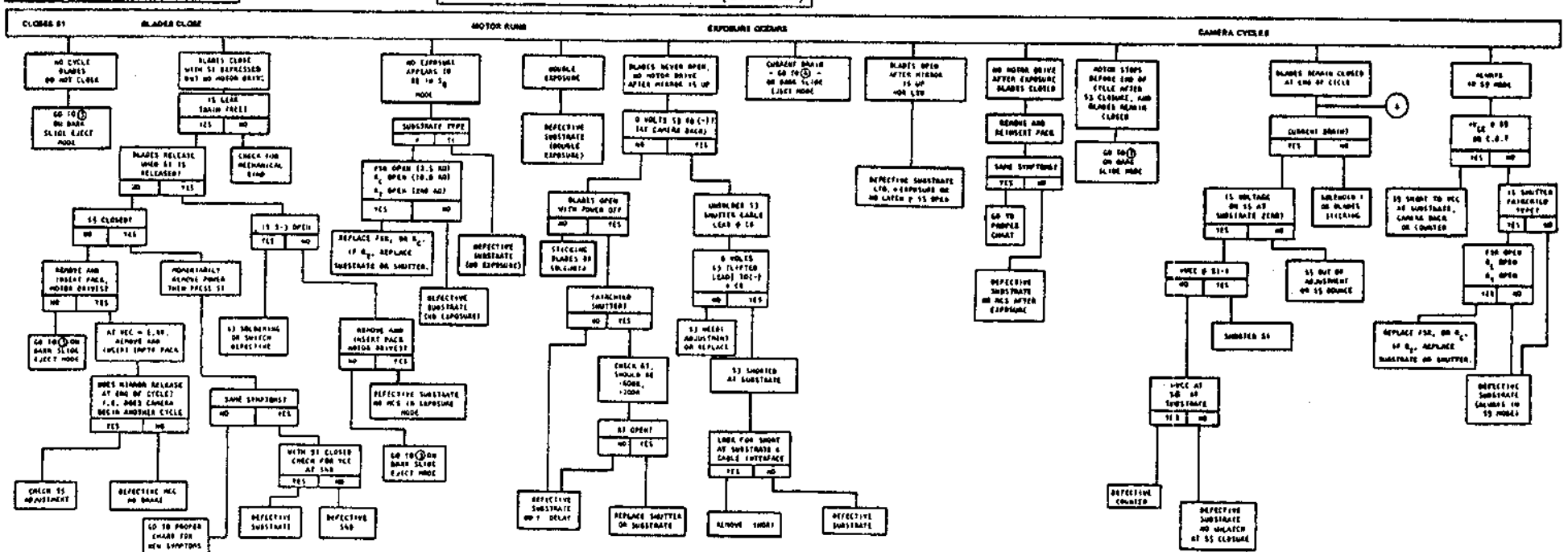
FAILURE ANALYSIS CHART #2

AMBIENT EXPOSURE MODE (CAMERA)


CLOSES S1
BLADES CLOSE
MOTOR RUNS
EXPOSURE OCCURS
CAMERA CYCLES
NO CYCLE BLADES DO NOT CLOSE
GO TO ① ON DARK SLIDE EJECT MODE
BLADES CLOSE WITH S1 DEPRESSED BUT NO MOTOR DRIVE
IS GEAR TRAIN FREE?
YES
NO
BLADES RELEASE WHEN S1 IS RELEASED?
CHECK FOR MECHANICAL BIND
S5 CLOSED?
(S 5-) OPEN
REMOVE AND INSERT PACK, MOTOR DRIVES?
MOMENTARILY REMOVE POWER THEN PRESS S1
GO TO ① ON DARK SLIDE EJECT MODE
AT VCC = 6.5V, REMOVE AND INSERT UNITS PACK
S1 SOLDERING OR SWITCH DEFECTIVE
DOES MIRROR RELEASE AT END OF CYCLE? I.E. DOES CAMERA BEGIN ANOTHER CYCLE
SAME SYMPTOMS?
CHECK S5 ADJUSTMENT
DEFECTIVE MCC OR BOARD
GO TO PROPER CHART FOR NEW SYMPTOMS
WITH S1 CLOSED CHECK FOR VCC AT SAB
DEFECTIVE SUBSTRATE
DEFECTIVE SAB
NO EXPOSURE APPEARS TO BE TO S_0 MODE
SUBSTRATE TYPE
P
N
FSR OPEN (2.5 kΩ) R_C OPEN (10.0 kΩ) R_2 OPEN (240 kΩ)
REPLACE FSR, OR R_C, IF R_2, REPLACE SUBSTRATE OR SHUTTER.
DEFECTIVE SUBSTRATE (NO EXPOSURE)
DEFECTIVE SUBSTRATE (END EXPOSURE)
REMOVE AND INSERT PACK, MOTOR DRIVES?
DEFECTIVE SUBSTRATE OR MCC IN EXPOSURE MODE
GO TO ③ ON DARK SLIDE EJECT MODE
DOUBLE EXPOSURE
DEFECTIVE SUBSTRATE (DOUBLE EXPOSURE)
BLADES OPEN WITH POWER OFF
STICKING BLADES OR SOLENOID
FAIRCHILD SHUTTER?
CHECK AT, SHOULD BE ~500Ω, ~100Ω
AT OPEN?
DEFECTIVE SUBSTRATE OR ? DELAY
REPLACE SHUTTER OR SUBSTRATE
BLADES NEVER OPEN, NO MOTOR DRIVE AFTER MIRROR IS UP
0 VOLTS S5 TO (-) IN CAMERA BACK)
UNSOLDER S1 SHUTTER CABLE LEAD @ CB
0 VOLTS S5 (LIFTED LEAD) TO (-) @ CB
S1 HEAT ADJUSTMENT OR REPLACE
S1 SHORTED AT SUBSTRATE
LOOK FOR SHORT AT SUBSTRATE & CABLE INTERFACE
REMOVE SHORT
DEFECTIVE SUBSTRATE
CURRENT DRAIN - GO TO ⑤ - ON DARK SLIDE EJECT MODE
BLADES OPEN AFTER MIRROR IS UP FOR LTR
DEFECTIVE SUBSTRATE LTR, (-)EXPOSURE OR NO LATCH @ S5 OPEN
NO MOTOR DRIVE AFTER EXPOSURE BLADES CLOSED
REMOVE AND REINSERT PACK
SAME SYMPTOMS?
GO TO PROPER CHART
DEFECTIVE SUBSTRATE OR MCC AFTER EXPOSURE
MOTOR STOPS BEFORE END OF CYCLE AFTER S2 CLOSURE, AND BLADES REMAIN CLOSED
GO TO ① ON DARK SLIDE MODE
BLADES REMAIN CLOSED AT END OF CYCLE
④
CURRENT DRAIN?
YES
NO
IS VOLTAGE ON S5 AT SUBSTRATE ZERO?
SOLENOID I OR BLADES STICKING
VMCC @ S1-1
S1 OUT OF ADJUSTMENT OR S5 BOUNCE
SHORTED S4
VMCC AT SAB AT SUBSTRATE
DEFECTIVE COUNTER
DEFECTIVE SUBSTRATE NO UNLATCH AT S5 CLOSURE
ALWAYS IN S0 MODE
V_{CC} @ S5 OR C.B.?
S5 SHORT TO VCC AT SUBSTRATE, CAMERA BACK OR COUNTER
IS SHUTTER FAIRCHILD TYPE?
FSR OPEN R_C OPEN R_2 OPEN
REPLACE FSR, OR R_C, IF R_2, REPLACE SUBSTRATE OR SHUTTER.
DEFECTIVE SUBSTRATE (ALWAYS IN S0 MODE)

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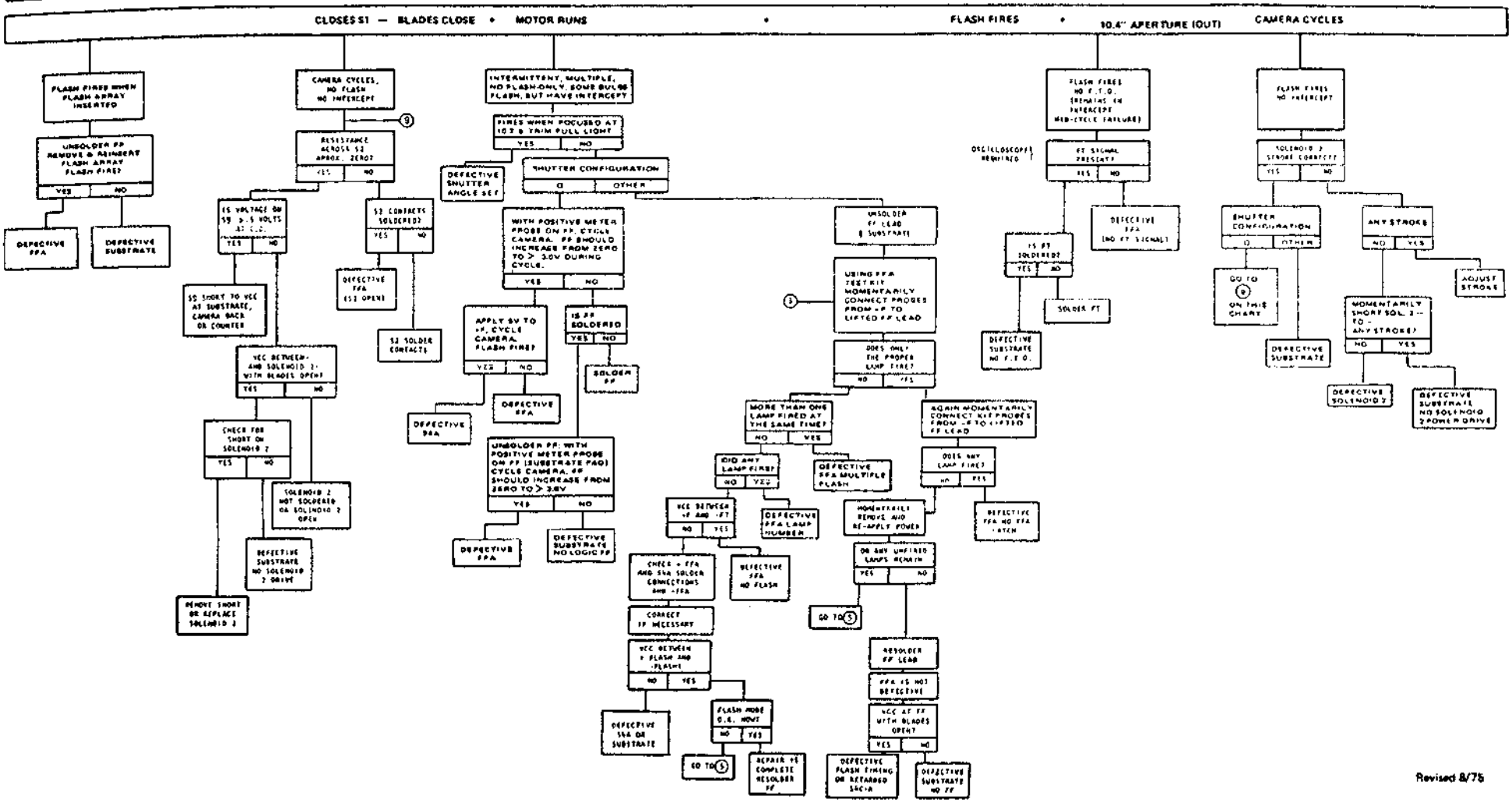
FAILURE ANALYSIS CHART #3

FLASH MODE (CAMERA)


CLOSES S1 — BLADES CLOSE • MOTOR RUNS • FLASH FIRES • 10.4" APERTURE (OUT) CAMERA CYCLES
FLASH FIRES WHEN FLASH ARRAY INSERTED
UNSOLDER FF REMOVE & REINSERT FLASH ARRAY FLASH FIRE?
YES NO
DEFECTIVE FFA
DEFECTIVE SUBSTRATE
CAMERA CYCLES, NO FLASH NO INTERCEPT
RESISTANCE ACROSS S2 APROX. ZERO?
YES NO
IS VOLTAGE ON S9 > 5 VOLTS
S2 CONTACTS SOLDERED?
S2 SHORT TO VCC AT SUBSTRATE, CAMERA BACK OR COUNTER
DEFECTIVE FFA (S2 OPEN)
S2 SOLDER CONTACTS
VCC BETWEEN AND SOLENOID 2 WITH BLADES OPEN?
CHECK FOR SHORT ON SOLENOID 2
SOLENOID 2 NOT SOLDERED OR SOLENOID 2 OPEN
DEFECTIVE SUBSTRATE NO SOLENOID 2 DRIVE
REMOVE SHORT OR REPLACE SOLENOID 2
INTERMITTENT, MULTIPLE, NO FLASH ONLY, SOME BULBS FLASH, BUT HAVE INTERCEPT
FIRES WHEN FOCUSED AT 10'2 & TRIM PULL LIGHT
YES NO
DEFECTIVE SHUTTER ANGLE SET
SHUTTER CONFIGURATION
0 OTHER
WITH POSITIVE METER PROBE ON FF, CYCLE CAMERA. FF SHOULD INCREASE FROM ZERO TO > 3.0V DURING CYCLE.
YES NO
APPLY 6V TO +F, CYCLE CAMERA. FLASH FIRE?
IS FF SOLDERED
DEFECTIVE 9VA
DEFECTIVE FFA
SOLDER FF
UNSOLDER FF: WITH POSITIVE METER PROBE ON FF (SUBSTRATE PAD) CYCLE CAMERA. FF SHOULD INCREASE FROM ZERO TO > 3.8V
DEFECTIVE FFA
DEFECTIVE SUBSTRATE NO LOGIC FF
UNSOLDER FF LEAD & SUBSTRATE
USING FFA TEST KIT MOMENTARILY CONNECT PROBES FROM +F TO LIFTED FF LEAD
DOES ONLY THE PROPER LAMP FIRE?
NO YES
MORE THAN ONE LAMP FIRED AT THE SAME TIME?
NO YES
DID ANY LAMP FIRE?
NO YES
DEFECTIVE FFA MULTIPLE FLASH
VCC BETWEEN +F AND -FF
DEFECTIVE FFA LAMP NUMBER
CHECK + FFA AND SHA SOLDER CONNECTIONS AND -FFA
DEFECTIVE FFA NO FLASH
CORRECT FF NECESSARY
VCC BETWEEN + FLASH AND -FLASH?
DEFECTIVE SHA OR SUBSTRATE
FLASH MODE O.K. MOUT
GO TO 5
REPAIR +F COMPLETE RESOLDER FF
AGAIN MOMENTARILY CONNECT FF PROBES FROM +F TO LIFTED FF LEAD
DOES ANY LAMP FIRE?
NO YES
DEFECTIVE FFA NO FFA LATCH
MOMENTARILY REMOVE AND RE-APPLY POWER
DO ANY UNFIRED LAMPS REMAIN
YES NO
GO TO 5
RESOLDER FF LEAD
FFA IS NOT DEFECTIVE
VCC AT FF WITH BLADES OPEN?
YES NO
DEFECTIVE FLASH TIMING OR RETARDED SHA
DEFECTIVE SUBSTRATE NO FF
OSCILLOSCOPE REQUIRED
FLASH FIRES NO F.T.O. REMAINS IN INTERCEPT MID-CYCLE FAILURE)
FT SIGNAL PRESENT?
YES NO
IS FT SOLDERED?
YES NO
SOLDER FT
DEFECTIVE SUBSTRATE NO F.T.O.
DEFECTIVE FFA (NO FT SIGNAL)
FLASH FIRES NO INTERCEPT
SOLENOID 2 STROKE CORRECT?
YES NO
SHUTTER CONFIGURATION
0 OTHER
GO TO 9 ON THIS CHART
DEFECTIVE SUBSTRATE
ANY STROKE
NO YES
ADJUST STROKE
MOMENTARILY SHORT SOL. 2 — TO — ANY STROKE?
NO YES
DEFECTIVE SOLENOID 2
DEFECTIVE SUBSTRATE NO SOLENOID 2 POWER DRIVE

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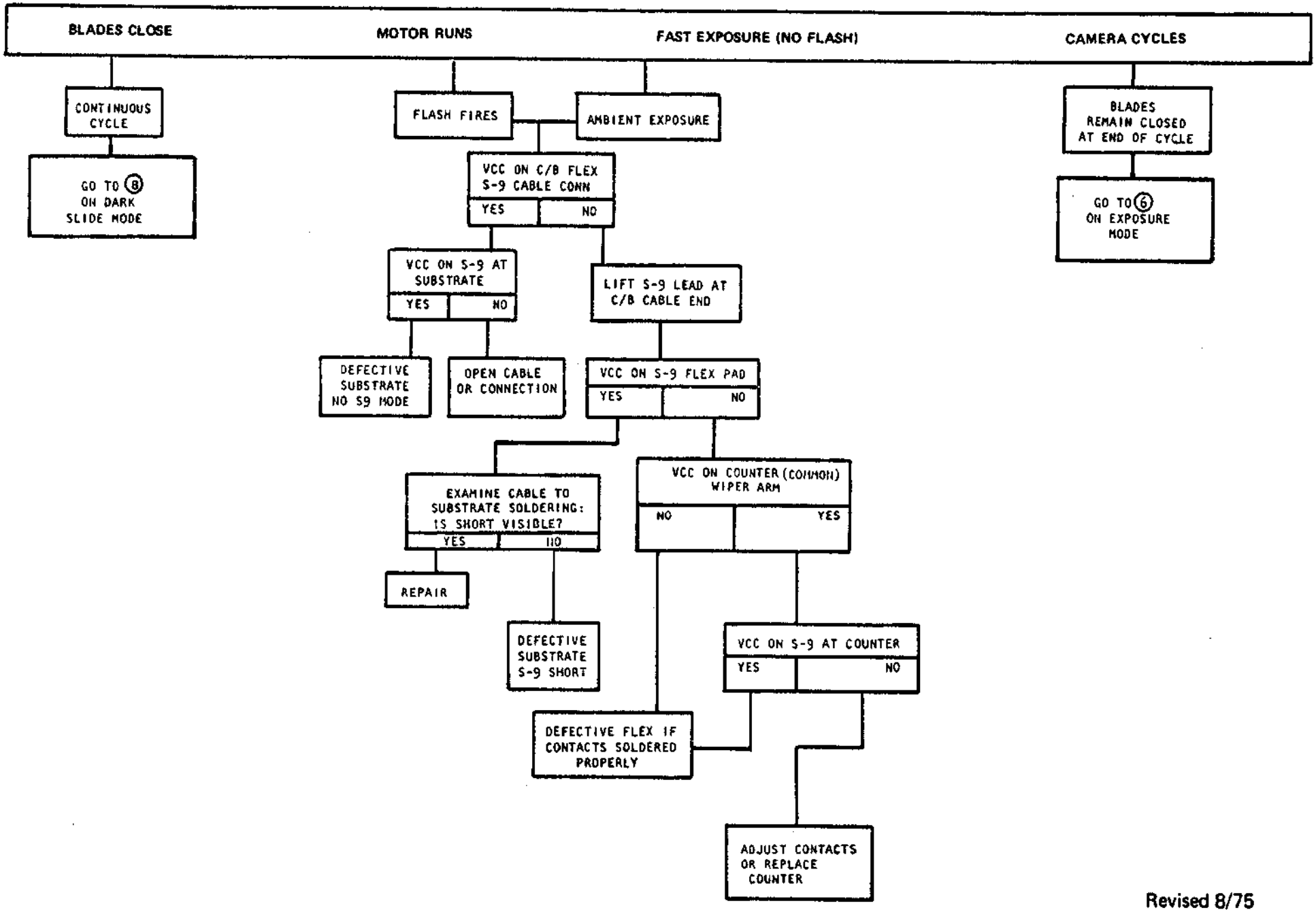
FAULT ANALYSIS CHART #4

EMPTY PACK MODE – S9 (CAMERA)



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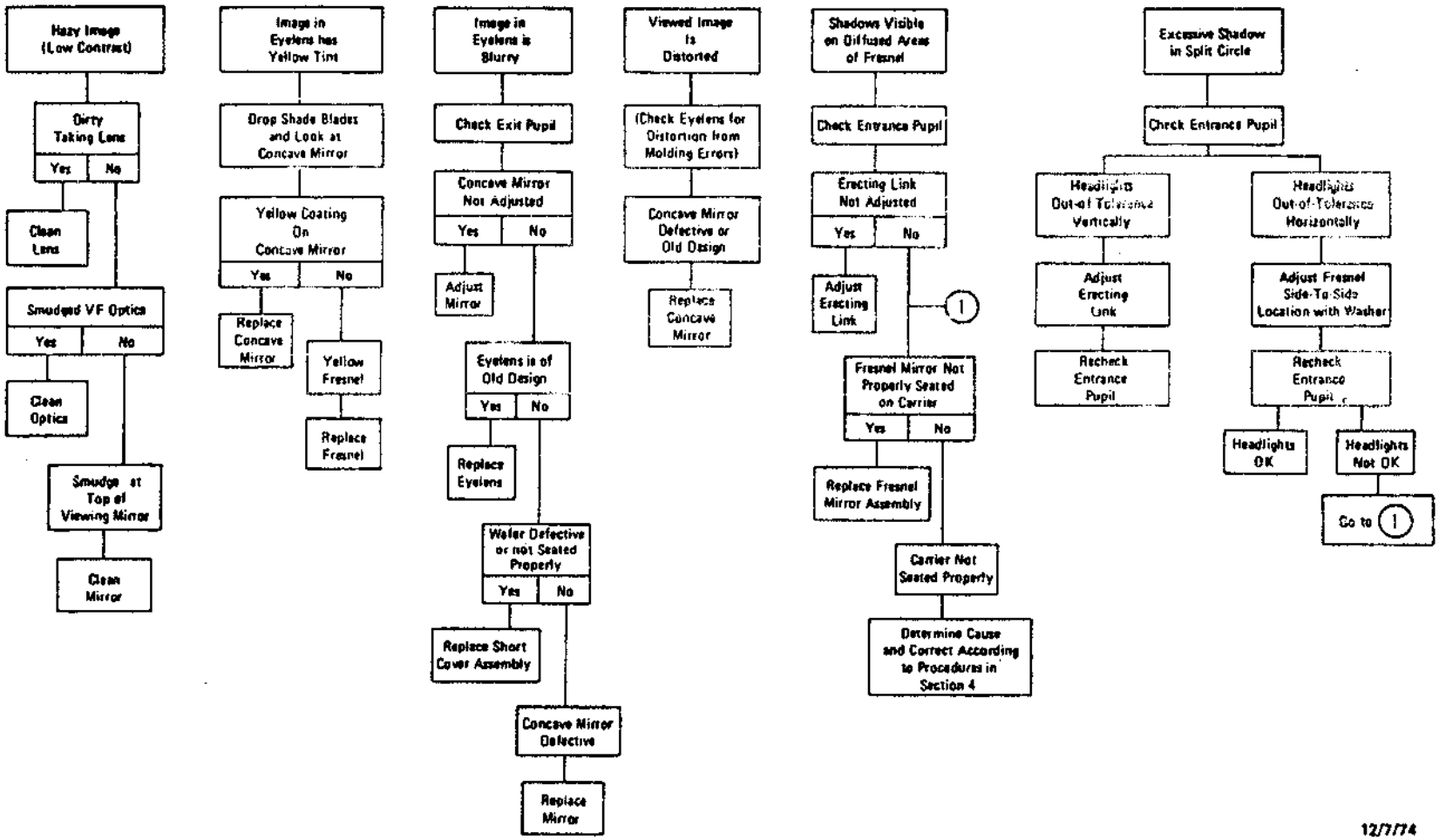
FAILURE ANALYSIS CHART #5

VIEWFINDER OPTICS (CAMERA)



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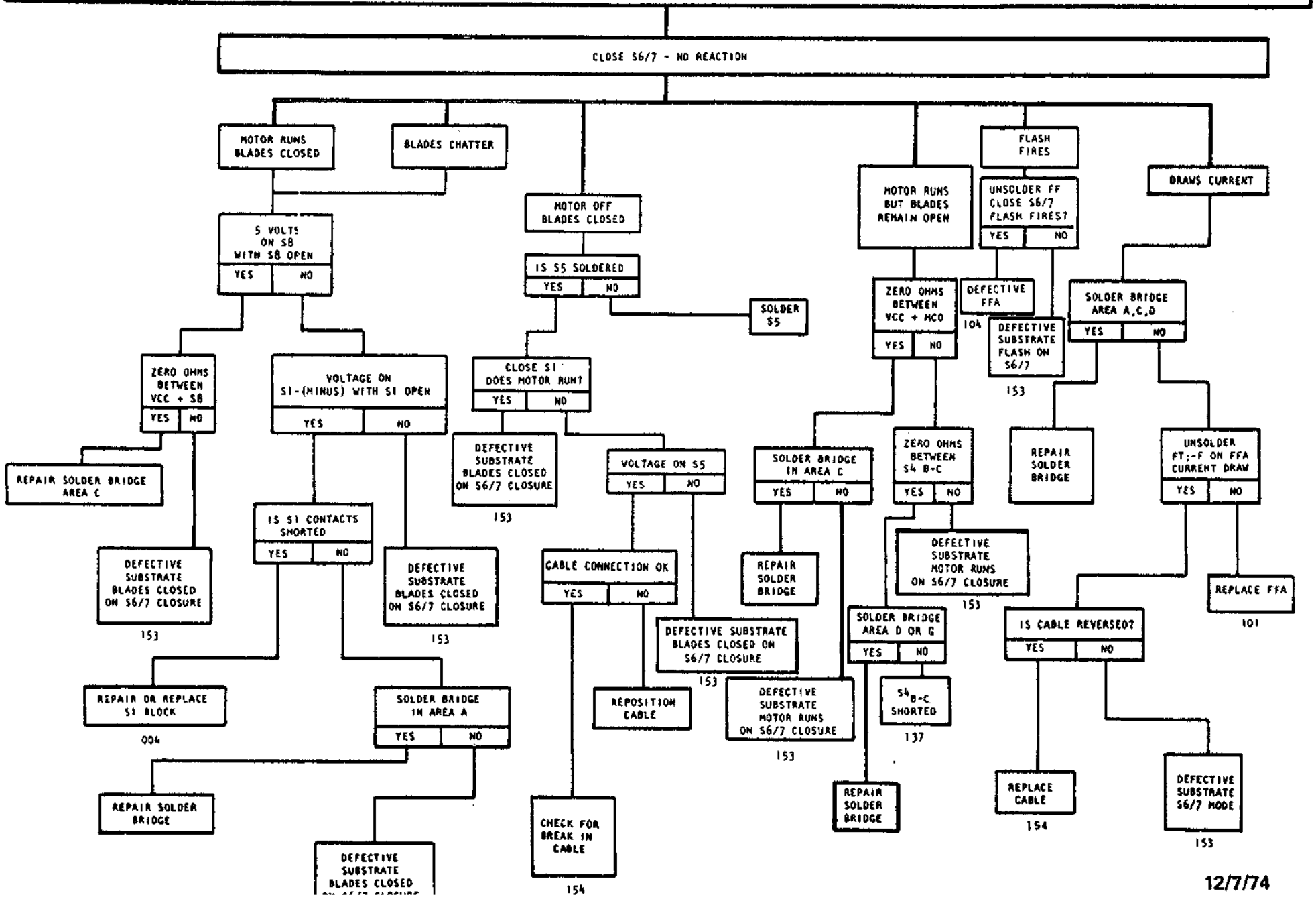
FAILURE ANALYSIS CHART #6

INITIAL CONDITIONS: S1, S8, S9, S6/7 OPEN; S3, S5 CLOSED

FAILURE ANALYSIS OF S6/7 CLOSURE (SHUTTER)

REJECT CODE 233



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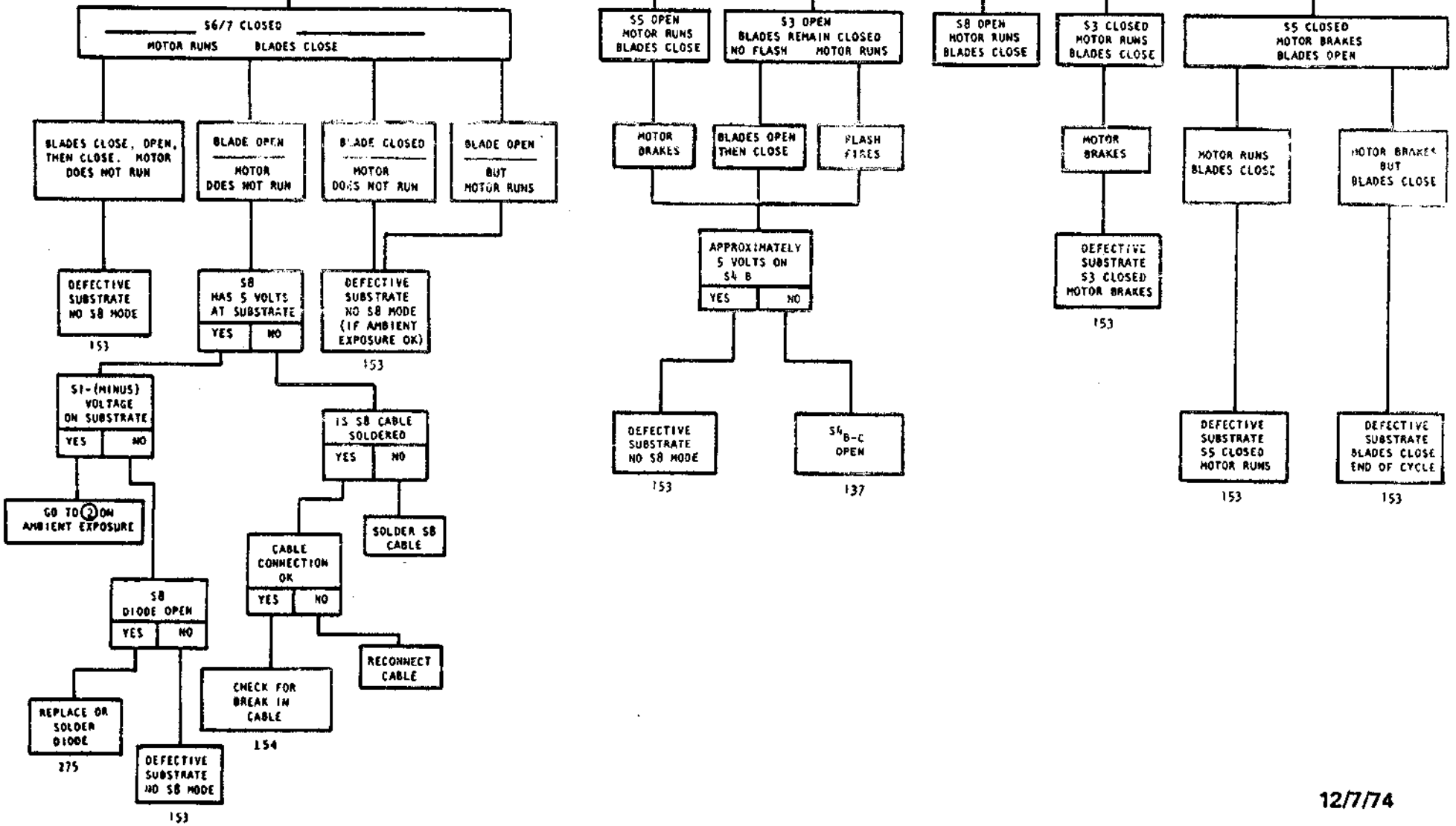
FAILURE ANALYSIS CHART #8

INITIAL CONDITIONS: S3, S5, S8 CLOSED; S1, S9, S6/7 OPEN

FAILURE ANALYSIS OF S8 MODE (SHUTTER)

REJECT CODE 236



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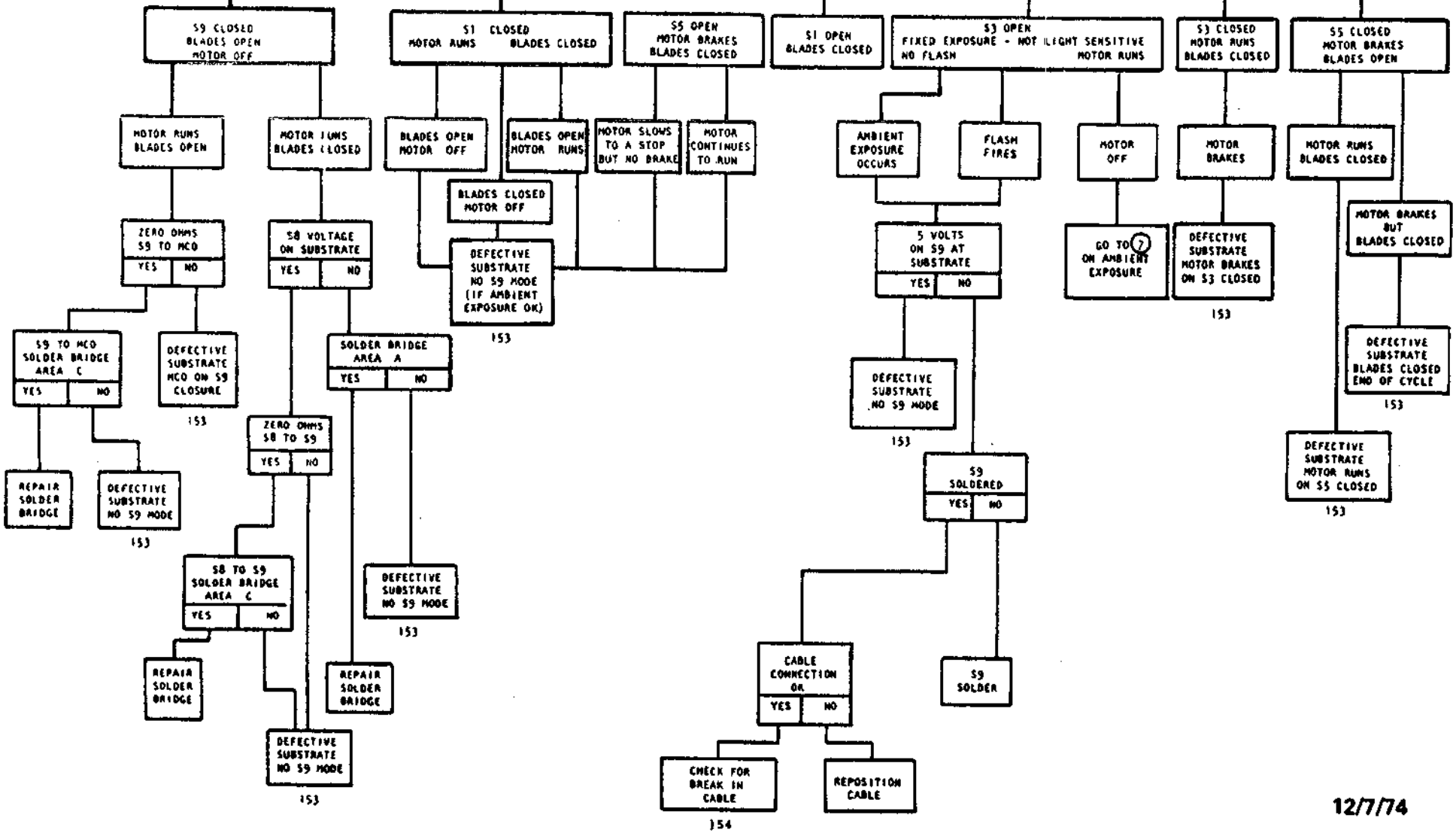
FAILURE ANALYSIS CHART #10

INITIAL CONDITIONS: S6/7, S3, S5 CLOSED; S1, S8, S9 OPEN

FAILURE ANALYSIS OF S9 MODE (SHUTTER)

REJECT CODE 237



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